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AN EXPERIMENTAL STUDY OF THE INFLUENCE OF INDIVIDUAL VS. GROUP INSTRUCTION ON SPATIAL ABILITIES IN PRESCHOOL CHILDREN.

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*PRESCHOOL CHILDREN, *EXPERIMENTAL PROGRAMS, SENSORY EXPERIENCES, *KINESTHETIC METHOD, *INDIVIDUAL INSTRUCTION, *GROUP INSTRUCTION, TASK PERFORMANCE, PERFORMANCE FACTORS, PERCEPTUAL DEVELOPMENT, HAPTIC PERCEPTION, CHESTNUT HILL, MASSACHUSETTS

THE IMPACT OF TWO TREATMENTS OF LEARNING EXPERIENCES ON THE ABILITIES OF PRESCHOOL CHILDREN WERE STUDIED. THE LEARNING EXPERIENCES INVOLVED PRINCIPLES OF HAPTIC (TACTUAL) PERCEPTION IN THE PERFORMANCE OF VARIOUS TASKS. CHILDREN, AGES 3 THROUGH 5, FROM HIGH AND LOW ECONOMIC LEVELS WERE SELECTED AS SUBJECTS. AN ANALYSIS WAS MADE OF THEIR HAPTIC PERCEPTION ABILITIES WHEN GIVEN INSTRUCTION, EITHER INDIVIDUALLY OR IN A GROUP. THEY WERE PRE- AND POST-TESTED IN FIVE AREAS OF HAPTIC ABILITY. DATA WERE ANALYZED BY F-RATIO AND CORRELATION COEFFICIENTS. THE 0.05 LEVEL INDICATED SIGNIFICANT DIFFERENCE BETWEEN THE MEANS AND FOR THE CORRELATION COEFFICIENTS. THE RESULTS INDICATED A NUMBER OF IDENTIFIABLE AND MEASURABLE VARIABLES WHICH PLAY AN IMPORTANT PART IN THE CHILD'S PERFORMANCE. HOWEVER, THE INSTRUCTION TREATMENTS DID NOT DIFFER SIGNIFICANTLY. (RS)

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September 1966

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

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Contract No. OE-5-10-288

Sister Josephina Concannon, C.S.J.

September 1966

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Boston College - School of Education

Chestnut Hill, Massachusetts

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TABLE OF CONTENTS

Page

ACKNOWLEDGEMENT iii

LIST OF TABLES v

LIST OF FIGURES vii

Chapter

I. RATIONALE FOR THE STUDY 1

Purpose of the Study
Limitations

II. REVIEW OF RELATIVE RESEARCH 6

Preschool Curricula
Montessori Methodology
Personality Testing for Young Children
Cognitive Beginnings of Spatial Concepts
Haptic Perception

III. DESIGN AND PROCEDURE 22

Grouping
Timing
Schools
Data and Instrumentation
Number of Logs
Equipment
Tests of Haptic Perception
Design
Treatment Stage
Type of School

IV. ANALYSIS OF DATA 35

Pre-test Data
Dependent Variable - Haptic Test Data
Hypotheses
Individual vs. Group Instruction
Summary of Hypotheses
Correlation Data
Montessori vs. Non Montessori Class

V. SUMMARY AND CONCLUSION 74

BIBLIOGRAPHY 80

APPENDIX 85

LIST OF TABLES

TABLE PAGE

1. Results of t - Tests Among Major Groups for Mental Ages and Chronological Ages 36
2. Means and Standard Deviations for Keister and Jack Tests of Personality 38
3. Mean Gain Scores in Haptic Learning for Five Criterion Measures for Major Subgroups 39
4. Analysis of Haptic Gain Scores by Sex 40
5. Analysis of Haptic Gain Scores by Schools 41
6. Analysis of Haptic Gain Scores by Sessions 41
7. Analysis of Haptic Gain Scores by Treatment 42
8. Analysis of Variance for Five Haptic Tests Between Experimental and Control Groups 43
9. Analysis of Variance for Five Haptic Tests Between Subjects in a Montessori and Subjects in a Non Montessori Class 44
10. Analysis of Variance for Five Haptic Tests by Sessions Attended 45
11. Analysis of Variance for Five Haptic Tests Between Boys and Girls 46
12. Summary of F - Ratios for Five Haptic Tests 47
13. Analysis of Variance for Five Haptic Tests with Increments in Mental Age and Chronological Age 48
14. Analysis of Variance for Five Haptic Tests by Previous Years in School 49
15. Analysis of Variance for Five Haptic Tests and Three Tests of Personality 50
16. Analysis of Variance for Criterion Measures Analyzed by School and Sex Interaction 51
17. Interpretation of F-Ratios for Haptic Tests by Treatment Interaction by Sex, School, and Session 52
18. Interpretation of F-Ratio for Haptic Tests by Experimental Treatment--Individual and Group 53
19. Intercorrelations Among Five Tests of Haptic Learning 59

LIST OF TABLES (Cont'd)

TABLE PAGE

20. Total Mean Gain Scores in Haptic Achievement Correlated with Independent Variables Dichotomized by Sex 60

21. Total Mean Gain Scores Correlated with Data Influenced by Class Membership 61

22. Total Mean Gain Scores Correlated with Scores of Ss According to type of Instruction 62

23. Significance of Differences for Montessori and Non Montessori Ss in the Initial Tests in Haptic Learning 63

24. Significance of Differences for Montessori and Non Montessori Ss in the Final Tests in Haptic Learning 64

25. Significance of Difference for Montessori Ss Between Mean Scores in Initial and Final Tests of Haptic Learning 65

26. Significance of Difference for Non Montessori Ss Between Mean Scores in Initial and Final Tests of Haptic Learning 66

27. Significance of Difference in Mean Initial Scores of Haptic Learning Between Experimental and Control Groups 67

28. Significance of Difference in Mean Scores in Final Tests of Haptic Learning Between Experimental and Control Groups 68

29. Significance of Difference Between Initial and Final Mean Scores in Haptic Learning for Ss in Experimental-Individual Treatment 69

30. Significance of Difference Between Initial and Final Mean Scores in Haptic Learning for Ss in Experimental-Group Treatment 70

31. Significance of Difference Between Mean Scores Between Ss in Experimental-Individual and Experimental-Group Treatment in Initial Test of Haptic Learning 71

32. Significance of Difference Between Mean Scores Between Ss in Experimental-Individual and Experimental Group Treatment in Final Test of Haptic Learning 72

LIST OF FIGURES

Figure Page

1. Schema for Research Assistants 22
2. Schema for Subject Placement 23
3. Schema for Lesson Allotment 32

CHAPTER I

RATIONALE FOR THE STUDY

The work of Piaget and Inhelder (1956) emphasized the importance of shape perception in the young child. One phase of their work, called haptic perception, the recognition of shape solely by touch cues, presented findings that young children build early in their development rather crude spatial relationships akin to topological geometry.

Montessori methodology (1912) recognized the importance of haptic perceptual learning through the emphasis on sensorial-tactual techniques. Both problems--haptic perception and the Montessori work--called for further study as related to preschool education.

Programs in early education prior to grade one have been most diversified in organization, curricula, philosophy, and personnel. Research data assessing the effectiveness of such programs in general have not been available. Universities have utilized the opportunities inherent in laboratory schools with fairly homogeneous groups and have contributed studies related to the various facets of growth and development.

Economic conditions of the thirties and the various federal aid programs for nursery and child care centers as a result of World War II gave rise to the establishment of preschool classes. Concomitantly, nursery schools came into focus mainly in the affluent sections of the cities. At the present time there is an apparent growing interest in preschool education programs due in no small measure to the emphasis given at the White House Conference on Education (1965), and by the recent report by the Educational Policies Commission (1966).

Heterogeneity of operation, involving type of housing, preparation and certification of personnel, and kind of curricula program is evident in the various preschool programs. In some areas little attention by state or local authorities has focused on preschool organization and certification of personnel.

Through government agencies and financial aid from philanthropic centers, the disadvantaged child has received opportunities for an early education. This is especially true in the large urban centers characterized by families of low income, minority groups, and the newly arrived migrant family with little, if any, speaking and understanding knowledge of the English language.

Parents, too, from upper economic levels, because of their concern with educational practices, recognized the importance of early education and have sponsored and organized preschool classes. Such an undertaking is understandable with people educated in the professions and financially able to share the cost of operating a private school.

Within the past two decades, the reappearance on the American scene of an apparently defunct methodology for educating young children (beginning at age two) has captured the interest mainly of oppulent parents. During Dr. Maria Montessori's lifetime (1870-1952) her method experienced only slight success in the United States. In the 1930's and 1940's less than five Montessori classes were in operation in this country. At present the movement expanding with a continuing number of new classes has received attention of university personnel where Montessori methodology is part of the curriculum in teacher education.

The increasing school enrollment with its many concomitant problems--societal and economic--calls for a re-examination of preschool educational practices.

A basic principle in the Montessori rationale involves the one-to-one type of instruction inherent in the methodology. Yet, in today's classes most curriculum plans utilize small group organizational patterns. Naturally, there is expected individualization of classroom instruction depending upon the content and purpose and where remediation is needed. To a Montessori teacher few, if any, group practices are countenanced.

Therefore, since group instruction characterizes American methodology and Montessori devotees insist that all teaching be individualized, an evaluation of both techniques was planned.

Psychological findings related to the young child stress the importance of good social adjustment as a function of well-timed learning experiences along with the ability to participate in group activities. With the varied preschool curricula practices stressing the academic, creative, intellectual, and social development, there was planned an assessment of the two common types of prevailing early childhood programs: Montessori and non Montessori classes.

Purpose of the Study

The proposed research project investigated the possible differential impact of individual *vs*. group treatment of experimentally induced learning experiences involving principles of haptic perception on the abilities of three, four, and five year old children to recognize haptically, to match haptically, to recognize a haptic presentation in topological form, to represent graphically the haptic form, and to verbalize a description of the haptic form. Contaminating factors such as C.A., M.A., sex, enrollment in a modified Montessori and a non Montessori type class, session attended (A.M.-P.M.), and selected personality factors were held-constant. The growth of perceptual abilities of a haptic nature in the absence of any planned learning activities was assessed for a control group and contrasted with that of the experimental groups.

Concomitantly, the study assessed in a three-pronged manner the achievement of Ss taught individually or in a group; from a Montessori or a non Montessori class; and treated experimentally or non experimentally.

The interesting and challenging Piagetian data related to the haptic abilities of the young child have received only passing attention from American researchers while in Russia and England there has appeared some replication of Piaget's findings. The present study used principles of haptic perception to assess the growth of Ss receiving either individual or group instruction in a series of planned lessons.

Early in their development, young children, according to Piagetian data build crude spatial relationships. Shape and form appear rather soon in the child's ability to abstract spatially along with his acquiring concepts of form constancy and permanency. Little data related to the abilities of generalization and differentiation accompanied by verbalization appear in the literature.

The stages of development outlined by Piaget are not universally accepted. Replication of some of Piaget's work by Page (1959), Ausubel (1963), Hunt (1961), Estes (1961), presented data which stressed the invariant levels of cognitive growth. Instead of the ontological sequence as emphasized by Piaget, the above findings attested that the child's development resulted from his learning experiences and environmental exposure. Bruner (1960), too, stated that anything can be taught to anyone if conditions are right. Consequently, a series of spatial learning activities measured the achievement of preschool Ss under varying treatments and types of instruction.

Limitations

Among the limitations inherent in the study were the size of the sample (N = 144), the length of time of the experiment, the possibility of the "Hawthorne effect," the personality, and competency of the experimenter.

The Ss from schools in urban, suburban, and inner city locales were typical of a preschool population. The learning activities involved novelty, innovating devices, interest, and active participation by the child.

In summary, the overarching concerns sought answers to these major questions:

1. What are the merits of group vs. a tutotial approach to learning with preschool Ss? If the former is as effective as the latter, the solution to economic and societal problems precipitated by an ever-increasing school enrollment should be facilitated.

2. Do play experiences requiring active feedback from the learner in terms of verbalization, active identification and matching, and graphic representation induce greater acceleration of learning than relatively free, unstructured play settings? Empirical evidence would bolster the data of the recent publication of the Educational Policies Commission (1966) and implement Bowles' prediction of schooling for everyone from 3 to 20 by 1980 (1963).

3. Can experimental verification be established for the assumption that tactual sensorial learnings from freely chosen media which are self-corrective induce more perceptual learning than is consequent with free play or neutral activities? These attempts to provide data evidencing greater perceptual learning for those exposed to modified Montessori experiences than to non Montessori or neutral experiences, should begin to bridge the gap between theory and fact.

The following hypotheses were tested by a multiple analysis of covariance:

1. Other things being equal there will be no significant parameter difference (1) between experimental treatments, (2) between types of instruction: individual vs. group, (3) between Ss in a Montessori and non Montessori class, (4) in the performance of Ss attending AM or PM session, (5) between sexes.

2. Other things being equal there will be no significant increments in the obtained value of the dependent variable (6) with increased C.A., (7) with

increments in M.A., (8) with years of previous schooling, (9) with size of increment in ascendancy (Jack Measure), and (10) with size of increments in constructiveness in face of failure (two Keister Measures).

Other things being equal, there will be no significant interaction between (11) treatment condition and type of school, (12) treatment condition and school session, (13) treatment condition and sex, and (14) type of school and sex.

The remaining chapters present a review of the literature, the research design and procedure, results of statistical analysis, summary and conclusions.

CHAPTER II

REVIEW OF RELATED RESEARCH

The chapter discusses research findings concerned with preschool curricula, Montessori methodology, concept formation, personality testing for young children, and finally haptic perception.

Preschool Curricula

For the past half century early childhood education has been a "no man's land" as far as curriculum organization or designs were concerned. Fuller (1960) attributed much of the diversity to the type of philosophy and the different origins: Froebel, Oberlin, Montessori, Bryan, and Hill. Notwithstanding the warring within the ranks, struggles for supremacy among divergent teaching and learning philosophies, and methods of dealing with the young child, the primary goal has been education.

In historical retrospect, Forest (1949) cited Rousseau as the first champion of young children. Rousseau's contribution considered significant is surpassed by Froebel (1782-1852) who formulated a theory and practice of early childhood education encompassed within a rationale even to the kind and use of teaching materials. For many years Froebel's pedagogical contributions formed the philosophic basis of thought and educational practices in preschool education.

Even today, in European schools (Holland) on the entrances is designated Froebel or Montessori, emphasizing the curriculum of the school.

In America there have evolved sound educational preschool programs due mainly to the interest in, elaboration and implementation of the scientific method carried out in university research centers. For the most part, laboratory schools operated as an adjunct to the university and included the kindergarten, enrollment in which usually entailed tuition thus cutting off a sizeable portion of the preschool and/or kindergarten population.

The White Conference on Education in 1965 devoted a significant portion of the program to Preschool Education. Getzels, as chairman of the session, summarized studies on cognitive abilities and stated that success in school is determined by the availability of relevant experience in the preschool environment (White House Conference, 1965).

The primary purpose of the day nursery school was to assist working mothers. The main goal was custodial in contrast to the educational objective of the kindergarten. University centers in the thirties encouraged study and experimentation in the nursery school whose objectives differed from those of the day nursery. Thus began the formal psychology of early childhood education, with an impetus by leading educators and psychologists interested in the child study movement with emphasis on research and experimentation.

Prior to 1964, no data on school attendance were available for ages 3 and 4. In 1964 the Current Population Survey reported that 25.5 per cent of children, ages 3 to 5, were enrolled in preschool classes. Of this number 4.3 per cent were 3 years old, and 14.9 per cent were 4 years old. Further analysis of these data revealed a concomitant and positive relationship between family income and percentage of children enrolled in preschool programs found mainly in the more affluent sectors of the cities and towns. Presently, there are 8,400,000 four-and-five-year-olds in the population of whom five million are not in school (Educational Policies Commission, 1966).

Receiving national publicity, a significant recent publication released by the Educational Policies Commission (1966) emphasized the importance of early education and stated that research data have indicated that the first four or five years of a child's life are the years characterized by the most rapid growth, physically and mentally and are most susceptible to environmental influences. Consequently, deprivations or other disadvantageous factors are most disastrous in their effects. The Commission aptly stated that society's postponement of an educational contribution until the child reaches the magical age of six generally limits the flowering of his potential.

The principle that early education is needed by all children -- the disadvantaged, pampered, physically handicapped, and those isolated from their peers, deprived of love -- received excellent treatment by the Commission (1966). Early universal education and therefore, government supported, was suggested along with the type of program differing basically from that of the traditional first grade.

Instructional objectives contained in the brochure encompass four major areas: physical, intellectual, emotional, and social, stressing curiosity, inventiveness, and enlargement of experiences. Research studies are needed since there remain many significant questions with no definitive or generally applicable answers: length of day, size of class, parent involvement, type of curriculum, (Educational Policies Commission, 1966).

With government appropriations within the past two years, the Project Head Start and similar programs added dimensions to the problem by assuming some responsibility for the early education of the child from a low income family. From many sources, -- federal, state, local, church, civic, and parent groups -- interest and concern for early childhood education have gone beyond the speculative and moved into the practical area of activity.

Montessori Methodology

The first woman to receive a medical degree from the University of Rome, Dr. Maria Montessori (1870-1952) contributed little to the field of medicine.

Paradoxically, she adopted a life-long career for which she possessed no formal professional preparation. Attracted by the condition of slum children in Rome, in 1907 she organized and directed classes for the day care of children. The first class operated only two years, 1907-1909. Through her voluminous writings for teachers and parents her fame spread to the United States. McClure's magazine became the vehicle for her writings. Many educators after spending time Doctor Montessori caught her enthusiasm for the potential and education of the young child.

Doctor Montessori culled many ideas from the works of Jean Itard (1775-1838) and Edouard Seguin (1812-1880). From their pedagogical materials she developed equipment similar in part but differing in use from the Froebelian apparatus. The materials, auto-corrective and applicable to use as early as age two, emphasized the development of all the senses.

Because of her medical background there were built into Montessori techniques many anthropological considerations now considered obsolete. Her writings, at times redundant, repetitious, and pietistic, paid only passing attention on the physical and psychological aspects of child development. Important also is the fact that findings concerned with the academic achievement objectively presented were conspicuously lacking. Self-activity, freedom of choice and length of time devoted to a task, a permissive discipline characterized the methodology.

Notwithstanding the many innovations and the commendable aspects of the method, critics arose in Europe (Culverwell, 1913; Boyd, 1914), and in America (Kilpatrick, 1914). A recent appraisal was that of Hymes (1965).

The criticism focused mainly on the rigidity of curriculum practices, lessening of the teacher's role, the complete freedom to select any task or activity for as long a time as desired, the theory of discipline concomitant with the principle of liberty, an almost total neglect of music, art, play, creative and imaginative activities as part of the heritage of early childhood education. A total ignorance of and a non desire to learn about American education alienated Montessori from the mainstream of educational and psychological leaders of the twenties and thirties. In fact, the method in the United States was practically defunct by 1940.

A recent text (Rambusch, 1962) presented a comprehensive bibliography on Montessori containing over 500 entries from 1909 to 1961.

The renaissance of the Montessori methodology was dual in nature: (1) the opening of the Whitby School in Greenwich, Connecticut, by Nancy Rambusch (1956), and (2) a publication by an associate of Montessori, Standing (1959) who described Maria Montessori and her work in an non objective, and extremely laudatory, repetitious, and at times boring presentation. According to Standing, whatever Montessori advocated should be immediately incorporated in the schools as a remedy for the deficiencies in American education (1959). It is of interest that Standing never taught in an American School. (Personal Interview). Because of the locale of the Whitby School publicity was easily obtained through TV, radio and popular reading material.

The basic Montessori principles advocated individual teaching, self-paced learning, a controlled environment for learning, self-correcting materials, and activities utilizing a tactile sense approach. Accompanying these factors in a Montessori environment one observes: absence of peer competition, avoidance of failure, concentration emanating from self-discipline, high interest level because of self-selection of the task, sensing one's progress immediately with auto-corrective materials, step-by-step progression in task performance somewhat related to the principle of machine teaching, ungraded class organization by chronological ages, viz., 3-4-5 year old children, and the de-emphasis of teacher autonomy.

Pitcher (1963) reported that schools for the young must be ready for the teaching of reading, writing, writing and arithmetic at an earlier age. In addition, Pitcher stressed the avoidance of mechanization in teaching that ultimately takes a toll in a lack of meaning, and that no child should be forced to use a single approach to a learning situation to the exclusion of others. Pitcher observed that basic in the philosophy of early childhood education is the undesirability of having only one system (Pitcher, 1963).

Montessori (1912), per se, advocated a single teaching method allowing for no deviation. Devotees of the Montessori methodology adhere very rigidly to the techniques, verbal instructions, and use of materials, critical of schools where there is an integration of methods. Although Pitcher did not mention Montessori, her critique applies to the structured presentation of lessons.

Hymes (1965) compared Montessori techniques with present day pedagogical practices found in American preschool programs and contrasted these interesting generalizations:

1. A Montessori curriculum does not include the vast contribution of children's literature. In non Montessori schools prose and poetry excellently written and illustrated are available for preschool children.
2. Techniques of reading readiness in terms of psychological data receive scant attention from a Montessori teacher. Tracing paper, sandpaper letters becomes mechanistic, is devoid of meaning, and unnecessary for the average and bright child. In contrast the curriculum for the non-Montessori child consists of meaningful exercises in rhyming, sensing likenesses and differences in words, letters and numbers, along with story-telling, listening experience, chart work, and a reading methodology which teaches for meaning.

3. First hand experiences, field trips, outdoor activities are missing in a Montessori program. In a non Montessori program these activities form the bases of much verbal and social learning.

4. Exercises involving dramatic play, puppetry, imagination, fantasy, and creativity in art, music, and rhythm are seldom used in a Montessori program. The realistic, prescribed, and highly structured program is rigidly followed. The mathematics, social studies and grammar techniques in a Montessori program are obsolete.

5. The practical life experiences of the Montessori curriculum appear nonsensible in today's culture. Cleaning and polishing shoes, shining silver and brass utensils, scrubbing clothes using a washboard in a zinc tub, carrying jars of water -- all such non-practical tasks give way to a more functional and meaningful curriculum in the non Montessori class in accord with the child's life today.

6. Experimentation, the right to learn by trial and error, and use of non-Montessori prepared equipment receive little if any support from Montessori devotees. Materials must be used by teachers and pupils solely in the way and for the purpose which Montessori prescribed. At times this rigidity is highly condemned.

7. Although Montessori received a scientific preparation in her professional work, no application of the scientific method appears in her writings. From Binet and DeSanctis were available intelligence instruments. Their use was criticized by Montessori.

8. Social interchange, movement of children in group activities, games, singing, and rhythmic play are absent in a Montessori class where often an unreal quiet atmosphere prevails. In fact, not even the teacher's voice should be heard, according to Montessori directives.

9. Leading the child to discover new ways of attempting tasks, with a lessening of teacher imposition and control characterizes the non Montessori class. In a Montessori environment following specific directions often by teacher pantomine is evident.

In the first summary of literature on Montessori, Claremont, a co-worker of Montessori, presented a defensible, subjective, and biased presentation. Castigating his contemporaries who disagreed with Montessori methodology, Claremont professed a strong fealty for, a profound esteem, and a total acceptance of all Montessori doctrine by taking out of context, statements which lost their true meaning when dissected apart from the total presentation.

In particular, Claremont singled out in an extremely critical way the contributions of Culverwell (1913), Boyd, (1914), Smith (1912), and the brief work by Kilpatrick (1914).

Many theses have reported fragmentations of Montessori methodology. Two recent contributions were a scholarly presentation by Ellison (1957) who examined Montessori's principles of discipline in the light of her contemporaries along with present day theories; Hymes (1965) who compared and evaluated some of the Montessori practices with those found in American preschool programs. These are listed by Donohue (Rambusch, 1962).

Gardner (1966) claims that Montessori's contributions concerning child development are largely unexplored and that a closer look at the Montessori method is pertinent. Gardner further stated that Montessori's insight into the appropriateness of intellectual training through sensory motor modalities at ages three to six is too little realized. In a comparison of sensory motor development of Montessori and Piaget, Gardner emphasized the relevance of Piaget's theory to the Montessori method.

Personality Testing for Young Children

Because of the negative reactions to the Montessori approach in toto, some modification resulted. Therefore, in the present study, selecting and implementing Montessori tasks with those effective activities in American preschool programs resulted in a modified curriculum conducive to the developing of those abilities characteristic of today's children: curiosity, inventiveness, creativity, socialization, physical growth, and intellectual competency.

Behavior studied individually and in a group was a factor considered important in the study. Search for an instrument useful with the young child revealed studies by Jack (1934) and Keister (1943). Materials were patterned according to the original studies. In the study for want of a better title, each test was described using the author's name.

The experience of failure occurs in human activities. Of importance is the problem of adjusting to the situation involving failure even in the life of the young child. Educators and psychologists state that failure at times can be effective incentive for performance for same individuals and also can play havoc in behavior processes.

Even the very young child meets many situations wherein he will not be successful. Failure in the life of the preschool child arises from many sources primarily in the home. Retreating from failure, leaning heavily on adult assistance, attacking the problem by outbursts and displays of negativism become undesirable methods in solving the situation.

Keister Test

Keister (1943) studied two groups of Ss, ages 43 to 72 months, matched in chronological age, sex, and intelligence. They were contrasted in terms of immature reaction to failure on a difficult puzzle and a task requiring considerable physical strength for their developmental level. Praise and support were given, but no assistance. Sessions were terminated with praise for the work. The control group did not show any significant improvement while the trained group made more attempts to solve the problem alone and exhibited less escape behavior.

A parallel study dealing with social behavior was conducted by Jack (1934) with Ss ranging from 45 to 56 months. Experimental and control groups were selected. After ten weeks of treatment the trained Ss showed greater gains in ascendance than the untrained group.

Cognitive Beginnings of Spatial Concepts

The present revival of interest in the cognitive processes of young children stemmed mainly from the work of Piaget and his co-workers in Geneva (1956). One of the few investigators who has examined the spatial problem in detail, Piaget described the acquisition of the concept as an object apart from oneself and possessing independent premanence as a necessary prerequisite for conceptual thinking (1956).

Piaget (1954), and Werner (1948) stated that children as early as eighteen months realize that objects have space, substance, and permanency.

Concomitant with the acquisition of concepts of object permanence is the acquisition of spatial concepts as cited by Sigel (Gibson, 1963).

Haptic Perception

In the United States the concept of haptic perception has received only passing recognition in psychological studies. Some reports have appeared in British and Russian journals, (Page, 1959; Boguslavskia, 1963).

Piaget and Inhelder contended that if the varied conceptualizations of children can reveal anything about intelligence and thought in general, then the concept of space assumes a priority rank and is deserving of study.

There have appeared haptic perception data related to art studies, especially those of Lowenfeld (1957) who defined "haptic" from the Greek "haptikos" meaning able to lay hold of and a tendency to synthesize tactile impressions of external reality and subjective experiences. Read (1958) similarly reported data on the haptic-minded individual in relation to art ability.

Piaget (1956) summarized data in haptic preception which he defined as the recognition of objects by touch in the absence of sight. He presented subjects a series of familiar objects and cardboard cut-outs of geometric shapes of varied complexities. Observation of their movements and ability to identify objects was noted. From this and other quasi-experiments Piaget and Inhelder divided the child's developmental progress into stages.

The stages as outlined by Piaget are:

Age 2.6 - 3.6 Stage I - A:	Finds familiar objects and recognizes them through tactile exploration.
Age 3.6 - 4.0 Stage I - B:	Beginning of ability to abstract shape. Not Euclidean but topological as open, closed, intertwined.
Age 4.6 - 5.0 Stage II- A:	Crude differentiation of rectilinear from curvilinear shape, while rectilinear or curvilinear shapes are not differentiated among themselves. Later in this stage there is differentiation of shapes according to angles.
Age 5.5 - 6.0 Stage II- B:	Discovery of specific shapes.
Age 6.0 - Above Stage III-	Methodological exploration-- child can distinguish between complex forms, as a star, cross, square.

Piaget defined space according to three categories -- topological, projective and Euclidean (1954). Topological refers to order, enclosure, continuity. Projective relates to object constancy while Euclidean deals with angularity, rectangularity and parallelism. Piaget indicated that children can recognize topological properties in the preoperational stage (2-7 years) and Euclidean operations are best understood by ages 9-10.

From England studies by Peel (1959), Lovell (1959), Page (1959), and Fisher (1965), replicated and/or extended Piaget's haptic experiment.

After scoring a pictorial set of drawings according to Piaget's stages, Peel (1959) reported findings with a high interjudge reliability for the 55 subjects of the same chronological age. The stage-by-stage progression in spatial representation as outlined by Piaget was essentially correct by Peel's findings.

In England, Lovell, Healey, and Rowland administered some of Piaget's experiments individually to sub-normal subjects. Broadly, the main stages as proposed by Piaget were confirmed. Lovell questioned the number of subjects in the Geneva experiment and stated that Piaget used 58 subjects from ages 4 through 9 but gave no breakdown by age range, (1959).

Page (1959) attempted to correct some shortcomings in Piaget's work. Sixty subjects ranging from 2.10 to 7.9 were observed in various ways: after feeling the form, subjects identified it by selecting it from the forms in view; subjects drew the form; finally, subjects performed both activities. Page did not list the independent variables as an aid in interpreting the findings. For example, the number of subjects in each state was omitted except for Stage I (14 children): the findings were reported as "16 correct responses" etc. This term is meaningless when there was no constancy nor number given in the total correct responses for the different tasks. No statistical analysis of data was reported. Page stressed the ease of recognition of topological forms over Euclidean.

Fisher (1965) in two haptic perception experiments, called the non-manipulative paradox and the topological primary hypothesis, reported data similar to Piaget. However, Fisher questioned the topological primacy and stated that it should be replaced by one of linear primacy. Data in this study were statistically treated with tests of significance. Whatever processes were involved in the development of the spatial operations, in situations of this kind at least, Fisher reported that they appeared to be completed by the age of about four years. Again, as in studies by Page and Lovell, independent variables as sex, IQ, schooling were not controlled. The statement was made that although the subjects were not given an intelligence test, on the basis of a subjective evaluation they appeared to be about 110 IQ points.

Long (1940) studied the roundness concept where subjects differentiated between a block and a ball. After training, all the subjects, ages 3 to 6, showed ability to grasp concept of roundness but had difficulty in extending concept of roundness to cylinders.

Gibson (1963) stated that research on vision as related to perception exceeded research on other modes of perceiving. He devoted an entire chapter in the Yearbook to perceptual development and emphasized Piaget's contribution. In addition, Gibson described the relation of Gestalt psychology to perceptual development in the use of geometric forms.

In commending the contribution of Piaget to the field of perceptual thinking, Wallach significantly commented on the lack of further Piagetian studies by American educators. Wallach (1963) presented reasons for this lack and stated that the Geneva studies contain a blending of empirical description with theoretical speculation frequently couched in complex, logico-mathematical terminology.

Working with 156 subjects from 3 to 5 years Benton and Schultz (1949) reported no significant differences in tactile haptic performance and sex, handedness, and chronological ages.

Flavell (1963) lamented that Piaget's developmental findings have not had an impact on curriculum in the United States. As an example the grade placement of content, e.g., geometry and basic elements of Euclidean representation, have not been taught at ages nine or ten, as advocated by the Piagetian stages of development. Piaget's work according to Flavell has not intruded substantially into curriculum planning nor into educational psychometrization in the United States. In England a vigorous movement is attempting to effect a liaison between Piaget and pedagogy (Lovell, 1959).

In an objective and scholarly presentation Flavell (1963) treated comprehensively the major contributions of Piaget. Flavell pointed out some of the lacunae in Piagetian data.

1. The absence of data related to subjects: age, number, intelligence, socio-economic background
2. The meager or missing conventional statistical treatment of results
3. The procedural design
4. The quasi-anecdotal rather than a quantitative presentation of data
5. The description of stages of development in a rigid presentation
6. The scant empirical data related to the acquisition of cognitive forms acquired in the course of ontogenesis
7. The omission of training procedures and control groups, and a consideration of environmental variables (Flavell 1963).

Notwithstanding these deficiencies, it is conceded that his research concerning the nature of child development rank Piaget as an outstanding contributor. Flavell (1963), Berlyne (1965), and Lindzey (1954) emphasized the need for the restudy of Piagetian data.

Fantz (1961) cited data which indicated that the ability to perceive forms is innate and that maturation and learning play significant roles in form development. In fact, Ling (1941) reported that as young as six months children were able to discriminate forms.

Fraisse and MacMurray obtained threshold values for four categories of materials among which were geometric figures: cross, star, circle, square. The shortest threshold value resulted for geometric line drawings for subjects whose mean chronological ages ranged from 6.9 to 11.1 (1960).

Of the contemporary researchers, Bruner (1956, 1957, 1960) has sparked renewed interest in cognitive learning, especially on the phenomena of categorizing and conceptualizing. Research scholars working with Bruner have contributed studies of cognitive processes which Bruner termed necessary for acquiring, organizing, and transforming symbolocally encoded information. One aspect of Bruner's work related the potential application of his cognition studies to the processes of elementary education.

Estes (1961) in a study of perceived size comparisons for figures of the same and different shape found no significant differences in type of cue used by subjects from kindergarten through college. Age and sex appeared to have no affect on performance. However, Estes stated that variability decreased with age.

Beilin and Franklin (1962) reported age differences for subjects in grade one through three in a study of the development of measurement (length, volume, area) but no major differences in intelligence in operational measurement. From their data they stated that measurement appeared in the order of length, area, and volume and not in the Piagetian order of volume, length, and area.

Using letter like forms as stimuli with sixty kindergarten subjects, Pick (1965) studied visual and tactual discrimination ability and transfer of learning. Final tests confirmed the hypotheses that training in discrimination did not affect transfer of learning.

Recently Russian research reported data in cognition studies bearing upon haptic perception. Boguslavskia (1963) and Zinchenko and Ruzskaya (1961) in somewhat similar studies analyzed the spatial development of the young child (ages 3 to 7 years) in his ability to identify geometric figures both by vision and touch. The findings indicated that visual recognition was better than tactile and that identification was not by form but by some other detail.

Piaget's dicta that certain ideas and degrees of abstraction can be given only at stated levels of development formed the basis for a recent conference (Goals 1963). It was agreed that more study was needed to resolve the question since data exist in conflict with Piaget's conclusions.

The Child's Conception of Space, where Piaget treated the problem, contained data on haptic perception. The quasi-experiment, as outlined by Piaget, formed the basis for the study complemented by a statistical paradigm with groups permitting comparison of achievement.

In summary research literature on haptic perception presented isolates studies especially in the United States. The major contributions have been those of Piaget and Inhelder, and from English and Russian psychologists.

CHAPTER III

DESIGN AND PROCEDURE

A letter explaining the purpose of the study was sent to the principal of each school. Consent was most graciously given. Each principal allotted space and time for the pre-and final testing and experimental activities. Excellent rapport between research assistants, teachers, and parents was evident.

Personnel

Five graduate research assistants from Boston College majoring in Counseling Psychology carried out the experimental phase. To offset the Hawthorne effect, the same assistants worked with the control Ss in group instruction.

The Ss in the control treatment were instructed as a group since their activities involved the usual type of preschool activity: singing, art, dramatics, play, speech, etc. Providing individual instruction was not feasible because of the nature of the neutral activities.

Figure 1 shows the schema for the research assistants.

Research Assistant	School	Time	Treatment
A - B	Chestnut Hill-Non Mont.	A. M.	Experimental and Control
A - B	Laboure " "	P. M.	"
C	Emmanuel " "	A. M.	"
D - E	St. Peter's- Montessori	A. M.	"
D - E	St. Peter's "	P. M.	"

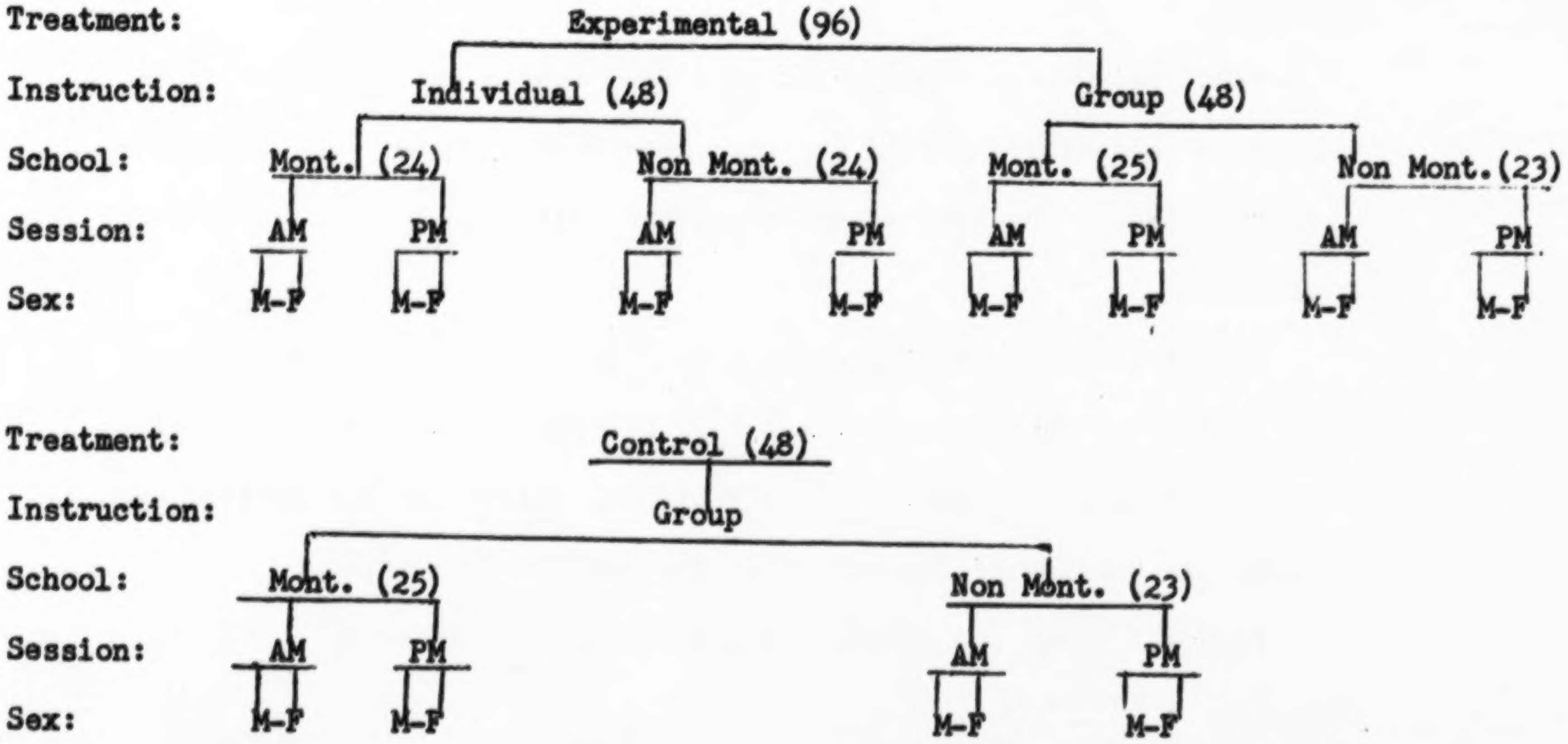
Fig. 1-Schema for Research Assistants

Grouping

From data for 144 Ss supplied by the school (name, age, sex, session attending) two major groupings resulted: 96 Ss in the experimental group and 48 Ss in the control group randomly assigned by sex and session.

The Ss in the experimental treatment were dichotomized by individual or group instruction while Ss in the control treatment were given group instruction only. Further breakdowns were made by type of school and session.

Figure 2 shows the schema for subject placement.


Treatment:
Experimental (96)
Instruction:
Individual (48)
Group (48)
School:
Mont. (24)
Non Mont. (24)
Mont. (25)
Non Mont. (23)
Session:
AM
PM
AM
PM
AM
PM
AM
PM
Sex:
M-F
M-F
M-F
M-F
M-F
M-F
M-F
M-F
Treatment:
Control (48)
Instruction:
Group
School:
Mont. (25)
Non Mont. (23)
Session:
AM
PM
AM
PM
Sex:
M-F
M-F
M-F
M-F

Total Montessori Ss = 74 Total Non Montessori Ss = 70

Fig. 2-Schema for Subject Placement

Timing:

Phase 1: January, 1965 - June, 1965

Phase 2: September, 1966 - January, 1966

Phase 3: March, 1966 - August, 1966

Phase 1 involved 1) contact with schools, 2) securing sample, 3) intelligence testing, 4) personality testing. Phase 2 involved the initial test of haptic abilities, 2) fifteen weeks of treatment activities, 3) final test of haptic abilities. Phase 3 involved final data processing and writing the report.

Schools:

1. The Emmanuel House locally supported and located in a low income area enrolls children ages 3, 4, and 5 for morning session only. The school is open to all children free of charge. About 75 per cent of the Ss are non white.

2. The Laboure School, similar to Emmanuel House, an all day care center, is tuition free. In the school, situated in a predominantly middle lower economic level, are white children. There are no non white families in the area.

3. The Chestnut Hill School, located in a suburban area, enrolls children from the upper levels. Children ages 3, 4, and 5 attend only a morning session, paying a fairly high tuition rate.

4. St. Peter School, an all day school, is situated in about the same level as Laboure School. Children ages 3, 4,or 5 attend either morning or afternoon sessions. These Ss comprised the Montessori taught population.

5. The Emmanuel House, Laboure School, and Chestnut Hill School supplied the non Montessori Ss and from St. Peter School came the Montessori Ss.

Data and Instrumentation

Complete background information on the 144 Ss was recorded on a master card. See Appendix, p. 85 for copy of evaluation card.

Psychometrization was completed prior to the beginning of the experiment and included mental age (months) from the Revised Stanford-Binet Test of Intelligence, Form L-M, administered by trained psychometrists.

Three personality measures were considered: one related to ascendant behavior (Jack technique), and two tests related to constructiveness when faced with failure as assessed by Keister.

Keister's material studied the child threatened with failure due to a difficult task.

1. Puzzle Box (10 minutes). The apparatus consisted of a box, 10" by 10" about 1-1/2" deep with a hinged lid which lay on top of the contents. The box was so made that on the inside it was only 1/4" in thickness. Plyboard forms of a sailboat, train, dog, clock, girl, flower, bird, mitten, and an airplane were easily handled by the child.

The problem was to place all the figures flat inside the box and close the lid. Even for an adult the task was difficult although at sight it appeared very easy to complete. When given the directions, each child immediately set to work. Timing began when the S touched the first form. During the 2nd and 4th minute, E encouraged S to keep trying. Further help was given at the 6th and 8th minute in the form of encouragement.

A verbatim record was kept of all responses. The overt behavior, expressive comments, and all verbalization were noted and recorded. Behavior was recorded in half minute intervals. Scoring equaled the number of seconds where no help was solicited and S worked independently.

2. Weighted Box (10 minutes). The apparatus was a wooden box 3' x 2' x 3', octagonal in shape and weighted inside with steel approximately 48 pounds. The S was told that there were toys underneath if he could life the box to get them. After instructions, E observed the child's reactions, checking his descriptive behavior. Comments of encouragement were made at the end of every two minutes until the ten minutes were up. Scoring equaled the number of seconds where the S worked with no sulking, crying, asking for help, or giving up.

Jack Test (10 minutes)

Children, observed by E behind a screen, played in pairs with groups of small plastic or rubber toys placed on a table.

The test assessed overt assertiveness and aggressiveness. The Ss placed with six of his peers, was observed for evidences of ascendant behavior while interacting in a group in a play situation.

Categories of identifiable behavior were as follows:

1. carries out own purpose and desires
2. directs behavior of others
3. forces own opinions or ideas on others
4. uses force against companions
5. gains recognition by expressions of rivalry, competitive spirit

Scoring equaled the number of minutes S worked non aggressively with the group. Description of test and sample performance appears in Appendix, p.86.

A scoring sheet for the personality data appears in Appendix, p. 93 .

Number of Logs

Pupil logs were completed after each treatment period: individual or group. The pertinent learnings and/or any difficulties encountered during the lesson were itemized. The research assistants kept a log or plan recording the objectives, content techniques, and comments for the weekly lessons.

Logs were evaluated by the research monitor and commented on during the conference with the research assistant. It was felt that the log was a feedback device providing the research director and the assistants with an awareness of the progress of the Ss. See Appendix for samples of pupil and teacher logs, pp. 94-104.

To secure a procedure of experimentation as uniform as possible, weekly conferences were held with the director and the research assistants. In addition many group and individual discussions took place concerning the work of the experiment. Frequent supervisory visits were made to the schools during the experimental period.

Equipment

Five sets of twenty plywood geometric forms devised by the writer comprised the pre and final testing equipment. They were sufficiently small for the child's hand to grasp and/or hold. See Appendix, p.105 for pattern of forms. Concealing the form was a cardboard screen 18" by 12" with a small opening which permitted the child's hand to grasp the form or forms haptically. The examiner sat opposite the S so as to place the geometric form or forms in order behind the screen. Uniform directions were provided for each research assistant.

Directions:

Test 1. Hand S form. "Tell me what are you feeling." Continue with 20 forms.

Test 2. Hand S three forms. "Find the two that are the same."

Test 3. After S felt form E said, "Find the same one on the card." Beside S was a 3" by 10" card on which were drawn five forms. S identified form on card.

Test 4. After S felt form E said, "Draw a picture right here." Paper marked with 20 spaces allowed S to reproduce form.

Test 5. S was asked to describe form. "Tell me all about what you are feeling."

For identification of forms, there were provided sets of unglazed cards, 3" by 10" with five drawn geometric designs. After the form was perceived haptically, S pointed it out on the card. See Appendix, p.106 for sample card.

Prior to and following the fifteen weeks of experimental work, Ss received a pre-and post-test. Each correct item received a score of one. The differences between the pre-and post-tests formed the dependent variables, or differential gain score. See Appendix, p.107 for score sheet.

With paper, pencils or crayons S reproduced the geometric form. Paper was blocked in twenty spaces with each numbered space corresponding to the haptic form.

Tape recorders (IBM) were used for those tests where a detailed verbal description of the form was given. The typescripts were made and data were transferred to the master sheet for evaluation and scoring.

Tests of Haptic Perception

Each of the five tests provided twenty scores or a total of one hundred correct responses both for the initial and for the final tests. The same twenty geometric forms were used in the five tests. Each test differed in the presentation and purpose. Thus, the E presented the form behind the screen and S performed the following tasks haptically:

Test 1. S handled topological geometric form and was asked to identify the shape. (Topological form provided three dimensions).

Test 2. After handling three forms S found the two which matched.

Test 3. After handling the topological form S identified the same form on a card with five Euclidean forms.

Test 4. After handling the form S reproduced it graphically.

Test 5. After S handled the form, he described it in more detail than in Test 1.

Equated for several treatment groups, the independent variables included: 1) chronological age (months), 2) mental age from Stanford-Binet Test of Intelligence, Form L-M (months), 3) sex, 4) school - Montessori - non Montessori, 5) session attended--morning - afternoon, 6) three personality factors--one from Jack and two from Keister Tests, 7) previous years in school.

Design

The general statistical approach to the analysis of the data was a multiple analysis of covariance. Each of the five gain score variables represented change or growth in one aspect of haptic recognition and served as the criterion variables of interest in a separate covariance analysis. Growth in a specific aspect of haptic recognition was indicated by the change from pre- to post-test performance in that aspect of haptic recognition. The four types of independent variables, experimental condition, school, sessions, sex were considered as factors for which main effects and certain interactions were tested in the presence of the four types of independent variables--M. A., C. A., years in school, and personality factors taken as the concomitant variables.

The computational analysis of the gain score criteria variables were based on vector concepts and multiple linear regression models described in Bottenberg and Ward, Applied Multiple Regression Analysis. Tests on main effects, interactions, and linear regression were made in this procedure by computing error sums of squares for appropriate full and restricted multiple regression models. The ΣS.S. (e.s.s.) for any regression model was obtained by computing the squared multiple correlation coefficient, R^2, for that regression model, and obtaining the ΣS.S. (e.s.s.) as Nx (criterion variance) x $(1 - R^2)$. This computational approach permitted the use of existing intercorrelation and multiple correlation computer routines. Another advantage of this approach was that it provided the correct solution for a system of normal equations when the orthogonality cannot be maintained between main independent factors.

The experimental design provided for the proportionality of N's in the various cells involving experimental treatment, type of school, sessions (A.M. - P.M.), and sex. These proportionality conditions were administratively possible and thus increased the sensitivity of the tests on the main effects and interactions.

The listing of the variables, specification of regression problems, appears in the Appendix, p. 108-112.

Using the forty-two variables for 144 cases, a correlation matrix was computed. With this matrix as input, a series of regression models was specified and R^2 for each model computed by using the appropriate set of independent variables from the matrix.

An identical set of regression problems was run and $R^{2's}$ computed with respect to independent variables using as the criterion (dependent variable X^2, X^3, X^4, and X^5. (X^1, X^2 . . . X^5 were differential gain scores).

All statistical analyses in the research project were computer processed using Fortran programs with existing Fortran subroutines for intercorrelation, multiple correlation, data transformation, F-ratio with corresponding probability level computation. Data transformation, F-ratio with corresponding probability level computation, and data passing subroutines were written for a vector and matrix operation framework, such as card to tape, tape to tape, etc. Dr. Robert Bottenberg of Lackland Air Force Base, Texas, the senior research design consultant, assisted in the preparation of the programs.

Computer programs were derived from A Fortran Listing of Persub Subroutines. The following subroutines were used and appear in attachments: Card to Tape, Tape to Tape, Datran, Regred, Correlb, and Prinsc. See Appendix, pp. 113-121.

Treatment Stage

With Ss randomized into groups, the experimental phase (15 weeks) began (See Figure 1, p. 22. Planned lessons of a haptic nature utilizing various manipulative materials were carried out by research assistants. Samples of lessons appear in Appendix, pp. 122-126.

During the experimental phase, Ss remained with the same instructor.

Figure 3 shows the treatment allocation for lessons during the experimental phase.

Experimental Treatment

Research Assistant	Type of Instruction	Class	N	Day - Time
A - C	Individual	Montessori	24	Mon-Wed-Fri.
B - D	Individual	Non Montessori	24	15 min. per S for 3 days per wk. Total = 36 hrs. per wk.
E - C	Group	Montessori (4 groups)	25	Mon-Wed-Fri.
D - E	Group	Non Montessori (4 groups)	23	15 min. per group for 3 days per wk. Total = 6 hrs. per wk.

Control Treatment

E - C	Group	Montessori (4 groups)	25	Mon-Wed-Fri.
E - D	Group	Non Montessori (4 groups)	23	15 min. per group for 3 days per wk. Total = 6 hrs. per wk.

Fig. 3-Schema for Lesson Allotment

The type of instruction was not differentiated for Ss in the control group because of the implausible effect of these differences on haptic recognition performance. Hence, Ss in the control treatment received group instruction.

Type of School

Seventy-four Ss attended a Montessori class with some modifications in the program. These modifications entailed small group activities for part of the session, along with music, art, etc. The major part of the day was devoted to the individual type of Montessori activity involving freedom of task, length of time devoted to task, individualization of teaching method, freedom to move within class. Many of the Montessori tasks emphasized sensorial learning, were self-corrective and self-pacing.

Activities and materials characterizing the Montessori class included the following:

1. sound boxes and bells for sound discrimination
2. tactual discrimination through feeling pieces of sandpaper, 4" by 2"; sandpaper letters and numbers; matching texture of cloth--blindfolded
3. baric weights - sense of touch
4. frame-buttoning, tying bows, hooking, lacing, etc.
5. geometrical metal insets--learning names as square, rectangle, etc.
6. tracing geometrical insets--left to right progression
7. matching geometric forms
8. cylinder matching - visual coordination
9. knobless cubes - cylinders visual coordination
10. erecting the pick tower - visual coordination
11. sorting the broad stair - visual coordination
12. using numbers with object - arithmetic readiness.

In the non Montessori class activities were free play, creative art, working with puzzles, clay, etc. However, because of their nature many activities in the non Montessori class appeared in a modified Montessori program as well.

In each school, a room completely apart from the regular classroom was given for the experiment. Either individually or in groups, the Ss came for treatment and instruction at a stated time. The examiner usually went to the classroom for the child or children. In the control situation, the Ss remained in the classroom, but worked with the examiner in a group of six in one of the following neutral activities.

1. rhythmic songs - finger plays
2. rhythmic dance - free movements, games
3. story telling--by teacher and by child - dramatic play
4. viewing child's classics in movies - (Make Way for Ducklings, Three Bears, Curious George, Jack in the Bean Stalk, etc.)
5. puppetry work
6. creative arts--using media as clay, paints, crayon, and finger paints
7. field trips - scenic and/or nature study
8. physical activities - outdoor games.

Avoidance of the Hawthorne Effect

The research assistants avoided giving the regular class teacher any helps or hints concerning the experiment. The teachers knew some Ss received experimental treatment. Other than knowing that some Ss came individually and others in a group, the specific learning activities were not explained to the teachers. To offset any effect of not being selected, Ss in the control group received various non haptic or neutral activities from the same research assistants who were involved with the experimental treatment.

Sample activities and lessons appear in Appendix, pp. 127-146.

CHAPTER IV

ANALYSIS OF DATA

Subjects from nursery and/or kindergarten classes divided by type of school and then by type of instruction formed the experimental and non experimental groups. Stratified random assignment, utilizing type of school, chronological age and sex placed Ss in experimental-individual, experimental-group treatment; and control group treatment. This stratification assured maximum efficiency and group equivalence. Control, or non experimental Ss were stratified in the same manner and were instructed in small groups since individual treatment appeared unfeasible. They received enrichment through the usual preschool activities.

The implicit problems were concerned with the effectiveness of treatment and type of instruction for Montessori and non Montessori pupils.

There was no subject attrition. When absences occurred the work was made up upon the child's return to school. The research assistants likewise were constant throughout the study.

Pre-Test Data

The mental ages were derived from the Revised Stanford-Binet Test of Intelligence, Form L-M and chronological ages were supplied by the school. Table 1 summarizes data in terms of t-test results for mental and chronological ages.

TABLE 1

RESULTS OF t-TESTS AMONG MAJOR GROUPS FOR MENTAL AGES AND CHRONOLOGICAL AGES

GROUP	Mental Age					Chronological Age			
	N	$\bar{x}$	σ	t	p	$\bar{x}$	σ	t	p
Mont.	74	63.5	12.53			54.4	8.30		
Non-Mont.	70	66.4	12.95	.65	>.05	56.8	8.68	1.69	>.05
Male	70	65.4	12.61			55.5	7.97		
Female	74	64.4	12.99	.22	>.05	55.8	9.10	.28	>.05
Exp.									
Ind.	48	65.7	11.67			54.3	8.60		
Group	48	66.8	13.48	.17	>.05	56.5	8.86	1.24	>.05
Total Exp.	96	66.3	12.52			55.4	8.73		
Control	48	62.2	12.86	.81	>.05	56.0	8.07	.41	>.05
Exp. Ind.									
Mont.	24	64.5	11.68			52.2	8.22		
Non M.	24	66.9	11.33	.72	>.05	56.4	8.47	1.74	>.05
Exp. Group									
Mont.	25	66.0	12.49			55.5	8.44		
Non M.	23	67.6	14.44	.41	>.05	57.6	9.17	.82	>.05

Data in Table 1 indicated that the major groups showed only slight variation in the obtained mean results for mental and chronological ages.

The mean mental age for 144 Ss was 64.2 months (5.35 years) with a standard deviation of 12.69 months (1.05 years); the mean chronological age was 55.6 months(4.63 years) with a standard deviation of 8.51 months (.708 years). The range in mental age was from 27 to 103 months and in chronological age from 36 to 71 months.

The sample was evenly divided by session, with 72 Ss attending morning and 72 Ss attending afternoon session. Four had attended school three years; 29 for two years; 48 for one year; and 63 were enrolled for the first time.

Dependent Variables - Haptic Test Data

Prior to and following the experimental phase the pre- and post-tests of haptic perception were administered individually by the research assistants. The testing required two or three sittings. See Appendix, p. 107 for scoring page. No S received a perfect score of twenty in any of the five pre-tests.

A breakdown of scores for the total sample (144) by categories or subgroups for pre- and post-test data appears in Appendix, pp. 148-150.

Personality tests were likewise administered. The scoring was recorded in seconds for the two Keister tests and in minutes for the Jack test. Total possible score for the two Keister tests was 600 seconds for each test; ten minutes for the Jack test. Deviation from the total score indicated observance of frustration (Keister) and aggression (Jack). Table 2 shows the mean and standard deviations for the personality tests.

Table 3 reports the mean gain scores for the five haptic tests by major subgroupings. The subgroupings appearing in Table 3 formed part of a larger set of independent variables analyzed by haptic gain scores for the particular group. A copy of the thirty-one variables appears in the Appendix, p. 108.

TABLE 2

MEANS AND STANDARD DEVIATIONS FOR KEISTER AND JACK TESTS OF PERSONALITY *

GROUP	Keister				Jack	
	I		II		III	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
Mont.	345.9	157.9	397.9	122.2	7.92	2.99
Non Mont.	341.6	185.6	484.8	111.9	5.07	3.29
Male	321.5	185.6	431.7	130.4	6.27	3.40
Female	365.0	156.3	448.1	119.3	6.78	3.47
Exp.						
Ind.	333.0	178.0	435.8	136.8	7.04	4.00
Group	311.8	180.5	448.9	125.9	6.31	3.08
Total Exp.	322.4	179.2	442.3	131.3	6.67	3.54
Total Con.	386.7	147.5	435.7	110.8	6.25	3.12

*Keister test recorded in seconds; Jack in minutes.

The differential gain scores (difference between pre- and post-test scores) were the major criterion measures used in the analysis of covariance. These mean gain scores appear in Table 3.

Tables 4 through 7 present means and standard deviations for haptic gain scores by sex, school, sessions, and treatment.

A summary of mean scores for initial and final tests in haptic performance appears in Appendix, p. 151.

TABLE 3

MEAN GAIN SCORES IN HAPTIC LEARNING FOR FIVE CRITERION MEASURES FOR MAJOR SUBGROUPS

GROUP	N	1		2		3		4		5	
		$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
Mont.	74	13.34	5.19	7.35	6.92	8.11	6.13	9.36	5.84	14.05	5.55
Non M.	70	6.66	5.43	2.30	3.95	1.23	4.09	5.56	4.20	7.37	5.10
Male	70	8.83	5.70	3.83	5.26	3.58	5.07	7.92	5.36	10.27	5.10
Female	74	11.03	4.66	5.87	5.41	3.82	4.76	7.16	4.53	11.13	5.06
Exp.											
Ind.	48	12.62	5.21	6.10	6.10	6.50	5.92	9.60	5.16	13.87	5.21
Group	48	12.25	5.38	5.23	6.03	5.65	6.23	9.85	4.91	13.06	5.67
Exp. Tot.	96	12.44	5.30	5.66	6.06	6.08	6.08	9.72	5.04	13.46	5.44
Con. Tot.	48	5.40	5.36	3.35	6.18	2.15	5.78	3.08	3.00	5.48	4.08
Ind. Exp.											
Mont.	24	16.21	2.81	9.12	6.90	10.17	5.22	12.21	4.91	17.33	2.44
Non M.	24	9.04	4.56	3.08	2.93	2.83	3.99	7.00	3.95	10.42	4.95
Gr. Exp.											
Mont.	25	15.60	3.72	6.88	6.87	8.72	7.09	12.24	4.96	17.24	2.92
Non M.	23	8.61	4.45	3.43	4.27	2.30	2.22	7.26	3.27	8.52	4.27

Data in Table 3 indicated Ss in Montessori class achieved consistently higher scores than Ss in non Montessori class for five tests.

TABLE 4

ANALYSIS OF HAPTIC GAIN SCORES BY SEX

Test	Total				Montessori				Non Montessori			
	Male (20)		Female (24)		Male (38)		Female (36)		Male (32)		Female (38	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
1	9.20	6.50	10.93	5.93	12.08	5.67	14.67	4.26	5.78	5.72	7.99	5.06
2	3.97	5.63	5.77	6.60	5.53	6.13	9.28	7.17	2.12	4.28	2.45	3.64
3	3.80	5.70	5.68	6.63	6.18	5.10	10.14	6.47	.97	5.08	1.45	3.05
4	8.06	5.77	7.00	5.09	9.50	6.40	9.22	5.19	6.34	4.32	4.89	3.97
5	10.56	6.52	11.04	6.07	13.66	6.02	14.47	4.97	6.87	4.99	7.79	5.15

TABLE-Continued

Test	Experimental-Individual				Experimental-Group				Control			
	Male (23)		Female (25)		Male (22)		Female (26)		Male (25)		Female (23)	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
1	12.22	5.28	13.00	5.12	11.82	5.20	12.62	5.49	4.12	5.32	6.78	5.04
2	4.04	5.00	8.00	6.40	4.55	4.28	5.81	7.13	3.40	6.99	3.30	5.15
3	6.17	5.35	6.80	6.37	3.41	4.20	7.54	6.99	1.96	6.35	2.35	5.08
4	9.78	5.48	9.44	4.04	11.17	4.72	8.23	4.47	3.20	2.73	2.96	3.26
5	13.39	5.70	14.32	4.68	13.86	5.18	12.38	5.97	5.04	4.24	5.96	3.84

TABLE 5

ANALYSIS OF HAPTIC GAIN SCORES BY SCHOOLS

Test	Experimental-Individual				Experimental-Group				Control			
	Montessori (24)		Non Montessori (24)		Montessori (25)		Non Montessori (23)		Montessori (25)		Non Montessori (23)	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
1	16.21	2.81	9.04	4.56	15.60	3.72	8.61	4.45	8.32	4.50	2.22	4.32
2	9.12	6.90	3.08	2.93	6.88	6.87	3.43	4.27	6.12	6.63	.35	3.82
3	10.17	5.22	2.83	3.99	8.72	7.09	2.30	2.22	5.52	4.89	1.52	4.23
4	12.21	4.91	7.00	3.95	12.24	4.96	7.26	3.27	3.76	2.44	2.35	3.36
5	17.33	2.44	10.42	4.95	17.24	2.92	8.52	4.27	7.72	4.04	3.04	2.35

TABLE 6

ANALYSIS OF HAPTIC GAIN SCORES BY SESSIONS

Test	Experimental-Individual				Experimental-Group				Control			
	A.M. (24)		P.M. (24)		A.M. (24)		P.M. (24)		A.M. (24)		P.M. (24)	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
1	12.54	5.38	12.71	5.05	12.21	5.22	12.29	5.53	4.79	4.18	6.00	7.27
2	5.92	6.83	6.29	5.26	4.62	4.47	5.83	7.20	2.96	6.53	3.75	5.78
3	6.46	6.12	6.54	5.70	4.42	5.20	6.87	6.89	2.54	6.26	1.75	5.22
4	8.75	4.74	10.46	5.42	9.92	4.89	9.79	4.93	2.93	2.78	3.25	3.19
5	13.29	5.78	14.46	4.51	12.62	6.03	13.50	5.25	4.62	4.17	6.33	3.79

TABLE 7

ANALYSIS OF HAPTIC GAIN SCORES BY TREATMENT

Test	Montessori				Non Montessori				Experimental			
	Exp. (49)		Control (25)		Exp. (47)		Control (23)		Ind. (48)		Group (48)	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
1	15.90	3.26	8.32	4.50	8.82	4.50	2.22	4.32	12.62	5.21	12.25	5.38
2	8.00	6.88	6.12	6.63	3.26	3.60	0.35	3.82	6.10	6.10	5.23	6.03
3	9.44	6.16	5.52	4.89	2.56	3.10	1.52	4.23	6.50	5.92	5.65	6.23
4	12.22	4.94	3.76	2.44	7.13	3.61	2.35	3.36	9.60	5.16	9.85	4.91
5	12.28	2.68	7.72	4.04	9.47	4.61	3.04	2.35	13.87	5.21	13.06	5.67

Time of day for number and length of session and teaching environment were constant throughout the fifteen week period. During the teaching period various manipulative materials were provided: blocks, geometric forms, flannelboard, large paper for illustrations, sand for tracing, plus pencils, crayons, clay, scissors, easels, etc., found in a preschool program. Each research assistant remained with the same Ss whether experimental or control throughout the experiment.

All data were computer processed with the various types of programming carried out by the senior research consultant, Dr. Robert Bottenberg. A list of the subroutines appears in Appendix, p. 113.

The F-ratio (probability level = .05) tested the homogenity of the variance among the means of the gain haptic scores. The four main effects, viz., treatment, type of school, sex and session attended were tested in the statistical hypotheses against the five gain mean scores for the specific variables. **A summary of F-ratios appears in Appendix, p. 152.**

Hypothesis 1: Treatment--Experimental vs. Non Experimental Groups.

Other things being equal there is no parameter difference in treatment. Table 8 presents F-ratios and probability levels for the five criterion measures analyzed by treatments: experimental and non experimental groups.

TABLE 8

ANALYSIS OF VARIANCE FOR FIVE HAPTIC TESTS BETWEEN EXPERIMENTAL AND CONTROL GROUPS

Test	Experimental (96)		Control (48)		F	p
	$\bar{x}$	σ	$\bar{x}$	σ		
1	12.44	5.30	5.40	5.36	42.15	<.000
2	5.66	3.35	3.35	6.18	1.64	>.19
3	6.07	6.08	2.15	5.78	10.11	<.000
4	9.72	5.04	3.08	3.00	43.35	<.000
5	13.46	5.44	5.48	4.08	62.89	<.000

Differential effects in five mean gain scores of haptic achievement (criterion measures) for experimental and non experimental Ss yielded empirical support for the rejection of the hypothesis for four of the haptic tests, favoring Ss in the experimental treatment. Data for Test 2, matching the haptic forms, indicate that although Ss in the experimental group achieved a higher mean gain score than Ss in the control group, the difference was not large enough to reject the stated hypothesis. In all criterion measures

Ss who received experimental treatment achieved greater gain scores than those receiving no special treatment.

Hypothesis 2: Type of School--Montessori vs.Non Montessori

Other things being equal there is no parameter difference in haptic performance between Ss enrolled in a Montessori class and Ss in a non Montessori class. Table 9 summarizes the F-ratios for the five mean gain scores by type of school.

TABLE 9

ANALYSIS OF VARIANCE FOR FIVE HAPTIC TESTS BETWEEN SUBJECTS IN A MONTESSORI AND SUBJECTS IN A NON MONTESSORI CLASS

Test	Montessori (74)		Non Montessori (70)		F	p
	$\bar{x}$	σ	$\bar{x}$	σ		
1	13.34	5.19	6.66	5.43	27.11	<.001
2	7.35	6.92	2.30	3.95	12.95	<.001
3	8.11	6.13	1.23	4.09	31.66	<.001
4	9.36	5.84	5.56	4.20	22.38	<.001
5	14.05	5.55	7.37	5.10	36.58	<.001

The resulting F-ratios, all significant beyond the .001 level of probability, reject the substantive hypothesis that the haptic mean performance of Ss from Montessori did not differ from Ss attending a non Montessori class. The five mean gain scores for the Montessori group (N = 74) were significantly higher than the five mean gain scores for the Ss in the non Montessori class.

Hypothesis 3: Session attended--AM *vs*. PM

Other things being equal, there is no parameter difference in haptic performance between Ss attending morning and those attending afternoon session. Table 10 presents the F-ratios for the comparison.

TABLE 10

ANALYSIS OF VARIANCE FOR FIVE HAPTIC TESTS BY SESSIONS ATTENDED

Test	Boys (70)		Girls (74)		F	p
	$\bar{x}$	σ	$\bar{x}$	σ		
1	9.85	5.37	10.33	5.93	.00	> 1.00
2	4.50	5.48	5.29	4.80	.35	> .55
3	4.47	5.43	5.06	4.76	.04	> .85
4	7.19	5.45	7.83	4.82	.68	> .41
5	10.18	5.51	11.43	4.40	2.97	> .08

From the data in Table 10 the empirical evidence supports the hypothesis that differences in achievement in haptic ability were not influenced significantly by the session attended. Therefore, the hypothesis is tenable. An interesting observation is that the mean scores for the five tests for the afternoon groups were slightly higher than the mean scores for the morning group.

Hypothesis 4: Sex

Other things being equal there is no parameter difference in haptic performance between the sexes. Table 11 summarizes the data for the F-ratios.

TABLE 11

ANALYSIS OF VARIANCE FOR FIVE HAPTIC TESTS BETWEEN BOYS AND GIRLS

Test	Boys (70)		Girls (74)		F	p
	$\bar{x}$	σ	$\bar{x}$	σ		
1	9.20	6.50	10.93	5.93	6.15	$<.01$
2	3.97	5.63	5.77	6.60	6.31	$<.01$
3	3.80	5.70	5.68	6.63	6.55	$<.01$
4	8.06	5.77	7.00	5.09	5.28	$<.02$
5	10.56	6.52	11.04	6.07	.49	$>.48$

The stated assumption that there is no parameter between sexes in haptic performance is untenable for four tests. The obtained F-ratios for four tests were significant at the .01 level except for Test 5. Boys and girls performed equally well in giving a verbal description of the haptic form. However, girls surpassed boys in all five mean results.

Table 12 summarizes the F-ratios for the four preceding hypotheses.

TABLE 12

SUMMARY OF F-RATIOS FOR
FIVE HAPTIC TESTS

Test	Boys - Girls		AM - PM		Montessori-Non Montessori		Experimental-Control	
	F	p	F	p	F	p	F	p
1	6.15	<.01	.00	>1.0	27.11	<.001	42.15	<.001
2	6.31	<.01	.35	> .55	12.95	<.001	1.64	>.19
3	6.55	<.01	.04	> .85	31.66	<.001	10.11	<.001
4	5.28	<.02	.68	> .41	22.38	<.001	43.35	<.001
5	.49	>.48	2.97	> .08	36.58	<.001	62.89	<.001

Hypothesis 5: Mental age and Chronological Age

There is no increment in obtained values of criterion variables with increments in mental age and chronological age. Table 13 summarizes the F-ratios analyzing effects of increased C.A. and M.A. on haptic performance.

TABLE 13

ANALYSIS OF VARIANCE FOR FIVE HAPTIC TESTS
WITH INCREMENTS IN MENTAL AGE AND CHRONOLOGICAL AGE

Test	Mental Age		Chronological Age	
	F	p	F	p
1	2.18	>.14	.46	> .49
2	1.21	>.27	5.98	< .01
3	.32	>.57	5.73	< .01
4	1.19	>.27	9.95	< .01
5	.16	>.68	.00	>1.00

Data in Table 13 support the hypothesis that increments in mental age do not affect haptic mean gain scores since the F-ratios for the five tests indicate non-significant differences. In the analysis using chronological age increments, hypotheses for Tests 2, 3 and 4 were rejected. The hypotheses related to Tests 1 and 5 are tenable since the obtained F-ratios were greater than the .05 level of probability. In summary mental age increments did not affect mean gain scores while chronological age increments showed significant differences in three tests of haptic perception.

Hypothesis 6: Previous School Attendance

Other things being equal there is no increase in the obtained value of the criterion variables with the increments in previous school experience. School records indicated that some Ss had previous school records, while the majority were attending school for the first year.

Table 14 shows the F-ratios for the comparison of the criterion measures and previous school attendance.

TABLE 14

ANALYSIS OF VARIANCE FOR FIVE HAPTIC TESTS BY PREVIOUS YEARS IN SCHOOL

Test	F	p
1	.84	>.35
2	.17	>.67
3	.87	>.35
4	1.95	>.16
5	1.58	>.21

From the data in Table 14, the hypotheses are tenable. The assumption that previous years in school has little effect upon haptic performance is evident.

Hypothesis 7: Personality Factors

It was hypothesized that other things being equal no increase would occur in the obtained criterion value with size of score in Jack technique--ascendancy, and with size of score in Keister technique--aggressiveness.

Table 15 shows these data for the analyses.

TABLE 15

ANALYSIS OF VARIANCE FOR FIVE HAPTIC TESTS
AND THREE TESTS OF PERSONALITY

Test	Jack Technique		Keister I		Keister II	
	F	p	F	p	F	p
1	1.49	>.22	.05	>.81	.12	>.15
2	2.26	>.13	1.56	>.21	.06	>.79
3	.14	>.69	.29	>.58	.05	>.81
4	.90	>.32	.15	>.69	1.28	>.25
5	2.10	>.14	1.08	>.30	2.02	>.15

Data in Table 15 support the null hypotheses concerning analysis of personality traits as measured by the Jack and Keister techniques and the five dependent variables of haptic learning. No significant differences in mean gain scores resulted when criterion measures were analyzed by the three personality factors in the study.

Hypothesis 8: School by Sex Interaction

Other things being equal there is no interaction with criterion measures analyzed by school and sex. To identify the variance between type of school (Montessori - non Montessori) and sex, F-ratios in Table 16 show the result of the interaction analysis.

TABLE 16

ANALYSIS OF VARIANCE FOR CRITERION MEASURES ANALYZED BY SCHOOL AND SEX INTERACTION

Test	School and Sex Interaction	
	F	p
1	.36	>.55
2	2.76	>.10
3	4.66	<.03
4	.47	>.49
5	.16	>.69

Interaction variances for the four tests of haptic ability report chance differences. In Test 3, identification of haptic form topologically, the obtained F-ratio was significant at the .03 level of probability and presents evidence of a differential effect of interaction of school by sex.

Hypothesis 9: Interaction of Treatment by Sex, Sessions, and School

Other things being equal there is no interaction with criterion measures analyzed by sex, sessions attended, and type of school. Assumption of these hypotheses was tested and Table 17 summarizes the F-ratio results.

TABLE 17

INTERPRETATION OF F-RATIOS FOR HAPTIC TESTS BY TREATMENT INTERACTION BY SEX, SCHOOL, AND SESSION

Test	Treatment by Sex		Treatment by Session		Treatment by School	
	F	p	F	p	F	p
1	1.13	>.32	.39	>.67	.43	>.65
2	2.20	>.11	.01	>.99	1.36	>.36
3	.76	>.47	1.10	>.37	.25	>.77
4	1.33	>.26	.44	>.64	4.74	<.01
5	1.38	>.26	.15	>.86	4.40	<.01

The data in Table 17 with two exceptions, interaction of treatment by type of school, sex, and session for Tests 4 and 4, substantiate the above stated hypotheses. The variance for the groups is fairly homogeneous, characterized by chance differences. Differences in interaction for Tests 4 and 5 reject the hypotheses that the mean difference would be zero.

Individual vs. Group Instruction

A major segment of the study compared the effectiveness of individual vs. group instruction. As stated previously 74 Ss were enrolled in a Montessori curriculum where major emphasis is placed on a one-to-one pupil-teacher ratio. Such a procedure, worthy as it appears, is not always feasible with the usual class of children. Again, group instruction possesses merits and advantages as related to learning adjustment. To study the effectiveness of a type of treatment, 48 Ss were given individual instruction and eight groups of six Ss (N = 48) received the same instruction for the identical period of time by the same instructor.

Hypothesis 10: Individual *vs.* Group Instruction

Other things being equal there is no parameter difference in mean gain scores in haptic learning between Ss receiving individual and Ss receiving group instruction during experimental phase of the study.

Table 18 presents the F-ratios analyzing the differences between the means of Ss by treatment.

TABLE 18
INTERPRETATION OF F-RATIO FOR HAPTIC TESTS BY EXPERIMENTAL TREATMENT--INDIVIDUAL AND GROUP

Test	Experimental				F	p
	Individual (48)		Group (48)			
	$\bar{x}$	σ	$\bar{x}$	σ		
1	12.62	5.21	12.25	5.33	.23	>.05
2	6.10	6.10	5.23	6.03	.59	>.05
3	5.50	5.92	5.65	6.23	.16	>.05
4	9.60	5.16	9.85	4.91	.22	>.05
5	13.87	5.21	13.06	5.67	.79	>.05

Data in Table 18 confirm the hypothesis that mean gain scores for Ss receiving individual treatment do not differ significantly from the mean gain scores for Ss receiving group treatment. With two exceptions, the mean gain score for Ss receiving individual instruction surpassed the mean gain score for Ss receiving group treatment.

A summary breakdown by major groupings of the analysis of the criterion values by type of instruction appears in Appendix, p. 154. All comparisons but one, resulted in F-ratios indicating no major differences in mean gain scores when analyzed by type of instruction. Male Ss receiving individual instruction performed significantly higher than Ss receiving group instruction.

The following statements summarize the differential effects in haptic achievement for the independent variables.

School Variable: Montessori vs. Non Montessori

1. In initial test results for non Montessori Ss surpassed Montessori Ss.
2. Final test results were higher for Montessori Ss than non Montessori Ss.

Treatment Variable: Experimental vs. Non Experimental

1. In initial test data Ss in experimental group surpassed Ss in control group.
2. Experimental Ss surpassed control Ss in final test data.
3. Initial and final mean gain scores for Ss in experimental treatment were significantly greater than the corresponding scores for the control group.

Instruction Variable: Individual vs. Group

1. No significant results resulted when final test data was analyzed by type of instruction. Individual or group instruction techniques resulted in slight differences in gain scores but not enough to influence significant performance. In only one comparison--Test 3--a significant difference favoring group instruction for males appeared.

The following summary identifies the resulting F-ratios.

Type of School: Montessori vs. Non Montessori

1. Subject attending the Montessori class (N=74) achieved significantly higher mean gain scores than Ss attending non Montessori class (N=70).

Test	1	2	3	4	5
F	27.11	12.95	31.66	22.38	36.58
p	.0001	.0001	.0001	.0001	.0001

2. Type of Treatment: Experimental vs. Control:

The mean gain scores for four tests for the Ss in the total experimental treatment (N = 96) exceeded those of the Ss in the control treatment (N = 48). In Test 2--matching forms haptically--only chance differences resulted.

Test	1	2	3	4	5
F	42.15	1.64	10.11	43.35	62.89
p	.001	.19	.001	.001	.001

3. Sex:

Examining the mean gain scores for boys and girls presented empirical data from which to derive probabilistic conclusions that sex differences exist except in Test 5--giving a verbal description of the form where only chance difference appeared. In three tests girls exceeded mean scores of boys.

Test	1	2	3	4	5
F	6.15	6.31	6.55	5.28	.49
p	.01	.01	.01	.02	.48

4. Chronological Age:

With the exception of Test 1 and Test 5 significant F-ratios resulted with increments in chronological age.

Test	1	2	3	4	5
F	.46	5.98	5.73	9.95	.00
p	.49	.01	.01	.001	1.00

5. Sessions:

Whether in attendance during mor afternoon session gain results were not indicative of substantial differences.

Test	1	2	3	4	5
F	.00	.35	.04	.68	2.97
p	1.0	.55	.85	.41	.08

6. Mental Age:

No significant findings appeared when the five criterion measures (gain scores) were analyzed by increments in mental ability.

Test	1	2	3	4	5
F	2.18	1.21	.32	1.19	.16
p	.14	.27	.57	.27	.68

7. Previous Years in School:

No interaction deemed significant appeared when mean gain scores were compared with previous school attendance.

Test	1	2	3	4	5
F	.84	.17	.87	1.95	1.58
p	.35	.67	.35	.16	.21

8. Interaction: Results in mean gain scores analyzed by school and treatment interaction presented data substantiating the null hypotheses with two exceptions--Tests 4 and 5 for interaction of treatment by school.

		Test				
		1	2	3	4	5
School x Sex	F	.36	2.76	4.66	.47	.16
	p	.55	.10	.03	.49	.69
Treatment by Sex	F	1.13	2.20	.76	1.33	1.38
	p	.32	.11	.47	.26	.26
Treatment by Session	F	.39	.01	1.10	.44	.15
	p	.67	.99	.37	.64	.86
Treatment by School	F	.43	1.36	.25	4.74	4.40
	p	.65	.26	.77	.01	.01

9. Personality:

Data indicated non significant differences when mean gain scores were compared with mean scores in failure, aggressiveness, and asserviveness.

		Test				
Personality		1	2	3	4	5
Keister I	F	.05	1.56	.29	.15	1.08
	p	.81	.21	.58	.69	.30
Keister II	F	.12	.06	.05	1.28	2.02
	p	.72	.79	.81	.25	.15
Jack	F	1.49	2.26	.14	.90	2.10
	p	.22	.13	.69	.34	.14

In summary, empirical support for the generalization of findings from initial and final tests derived from the F-ratio indicated:

1. non chance differences in five _initial_ tests between Montessori and non Montessori classes--favoring non Montessori class
2. non chance differences in three _final_ tests between Montessori and non Montessori classes favoring Montessori class
3. non chance differences between mean scores in _initial_ and _final_ tests for Montessori and non Montessori classes favoring Montessori class
4. non chance differences in Test 1 in _initial_ tests of haptic learning between experimental and control groups with only slight and chance differences in Tests 2, 3, 4, and 5.
5. non chance differences in _final_ tests of haptic learning between experimental and control groups--favoring experimental group
6. non chance differences between _initial_ and _final_ test scores for experimental individual and experimental group treatment
7. in comparing initial and final haptic test scores by treatment and instruction (experimental-individual _vs_. experimental-group) the F-ratios indicated only chance differences.

Correlation:

In each of the five tests of haptic ability the handling of twenty geometric forms assessed a different competency.

Test 1: Ability to identify form--a word or phrase sufficed

Test 2: No verbalization but S found among forms the two which matched

Test 3: No verbalization - After handling topological form, S found the Euclidean form on card (3" by 10" containing 5 forms) one of which was correct form

Test 4: No verbalization but S reproduced form graphically in a given space

Test 5: S handled form and verbalized to a greater degree than that required in Test 1.

Because of the similarity of the tests it was assumed that the intercorrelations would be positive. Table 19 shows the intercorrelation coefficients for the five tests for 144 Ss. A complete correlation matrix for the 42 variables appears in Appendix, p.152. A listing of the variables appears in Appendix, p. 108.

TABLE 19

INTERCORRELATIONS AMONG FIVE TESTS
OF HAPTIC LEARNING

Test	Criterion Test				
	1	2	3	4	5
1	---	.42	.52	.53	.79
2	.42	---	.59	.16	.37
3	.52	.59	---	.23	.50
4	.53	.16	.23	---	.60
5	.79	.37	.50	.60	---

All correlations were positive and significant at .05 level for 142 df.

Each of the independent variables was correlated with the criterion scores. Table 20 summarizes the correlation data for the criterion measures and variables dichotomized by sex.

TABLE 20

TOTAL MEAN GAIN SCORES IN HAPTIC ACHIEVEMENT CORRELATED WITH INDEPENDENT VARIABLES DICHOTOMIZED BY SEX

Male - Female	df	Criterion Test				
		1	2	3	4	5
Exp. Ind.						
Male	21	.15	-.06	.10	.18	.18
Female	23	.21	.23	.15	.16	.26
Exp. Group						
Male	20	.12	-.02	-.09	.33	.21
Female	24	.19	.07	.21	.06	.12
Control						
Male	23	.44'	-.11	-.21	-.36	.42'
Female	21	-.23	-.11	-.17	-.36	-.34
Montessori						
Male	36	.19	.06	.14	.22	.27
Female	34	.42'	.41'	.50'	.18	.34'
Non Mont.						
Male	30	-.37'	-.24	-.32	-.11	-.33
Female	36	-.26	-.24	-.32'	-.29	-.29

'Significant at .05 level.

An inspection of Table 20 reveals consistently low results. Negative r's appeared. The comparison of criterion scores with scores of Montessori-Male and Female appear to be the only one with positive and significant results. In this comparison, with one exception, the r's for females are higher than the r's for males when mean scores for Control-Male and Female, Non Montessori-Male and Female were correlated with total gain score.

Since the study dealt with Ss from Montessori and non Montessori classes correlation data are summarized by criterion variables affected by class membership.

TABLE 21

TOTAL MEAN GAIN SCORES CORRELATED WITH DATA INFLUENCED BY CLASS MEMBERSHIP

Independent Variable	df	Criterion Test				
		1	2	3	4	5
Montessori	72	.53'	.40'	.54'	.34'	.53'
Non Montessori	60	-.53'	-.40'	-.54'	-.34'	-.53'
Mont. Exp. Ind.	22	.44'	.30	.39	.39	.46'
Mont. Exp. Group	23	.40'	.15	.29	.40'	.47'
Non Mont.Exp. Ind.	22	-.07	-.13	-.13	-.04	-.02
Non Mont.Exp.Group	21	-.54'	-.31	-.44'	-.41'	-.53'
Mont. Control	23	-.13	.09	.05	-.31	-.22
Non Mont. Control	21	-.54'	-.31	-.44'	-.41	-.54'

'Significant at .05 level.

Data in Table 21 related to Montessori Ss are significant indicating a close relationship between criterion score and specific variables influenced by type of school. Exceptions appeared: data for Ss in Montessori Control revealed low and inverse relation.

Correlation data related to the performance of Ss receiving individual treatment with Ss receiving group treatment are shown in Table 22.

TABLE 22

TOTAL MEAN GAIN SCORES CORRELATED WITH SCORES OF SS ACCORDING TO TYPE OF INSTRUCTION

Independent Variable	df	Criterion Test				
		1	2	3	4	5
Total Exp. Ind.	46	.29'	.14	.20	.27	.34
Total Exp. Group	46	.24	..04	.10	.30	.25
Exp. Individual						
Montessori	22	.47'	.30	.39	.38	.46'
Non Mont.	22	-.07	-.13	-.14	-.04	-.03
Exp. Individual						
A.M.	22	.17	.07	.12	.10	.25
P.M.	22	.19	.10	.13	.24	.13
Exp. Individual						
Male	21	.14	-.06	.10	.18	.17
Female	23	.21	.22	.15	.16	.25
Exp. Group						
Montessori	23	.40'	.15	.29	.39	.47'
Non Mont.	21	-.10	-.10	-.17	-.02	-.15
Exp. Group						
A.M.	22	.15	-.02	-.02	.20	.13
P.M.	22	.16	.07	.15	.19	.19
Exp. Group						
Male	21	.12	-.02	-.09	.33	.21
Female	24	.19	.07	.21	.06	.12

'Significant at .05 level.

A consistent positive correlation appeared for the independent variable related to data from individual and group instruction. Similarly, a positive correlation appeared when data from Ss in a Montessori class receiving either individual or group instruction were compared with criterion scores.

Montessori vs. Non Montessori Classes:

As previously stated little data, empirically determined, were available in the literature related to performance of Ss in Montessori and Ss in non Montessori classes. Therefore, dichotomizing Ss by type of school F-ratios tested the significance of the difference between the two groups in haptic performance of initial and final tests.

Hypothesis 11: Other things being equal there is no parameter difference in mean initial test data between Ss dichotomized by school.

In comparing initial mean scores for Montessori and non Montessori Ss, F-test data are reported in Table 23.

TABLE 23

SIGNIFICANCE OF DIFFERENCES FOR MONTESSORI AND NON MONTESSORI SS IN THE INITIAL TESTS IN HAPTIC LEARNING

Test	N	$\bar{X}$	σ	F	p
1					
Montessori	74	2.57	3.21	41.86	<.001
Non Montessori	70	7.10	4.90		
2					
Montessori	74	8.85	6.69	25.10	<.001
Non Montessori	70	13.41	3.82		
3					
Montessori	74	9.20	6.28	22.18	<.001
Non Montessori	70	14.39	4.23		
4					
Montessori	74	1.59	2.30	26.11	<.001
Non Montessori	70	4.71	4.59		
5					
Montessori	74	1.68	2.48	46.24	<.001
Non Montessori	70	5.76	4.47		

The obtained initial gain score for non Montessori groups is significantly different from Montessori groups. Each F-ratio is significant beyond the .001 level favoring the non Montessori class. Therefore, the hypothesis as stated is rejected for all tests.

Hypothesis 12: Other things being equal there is no difference in final test performance in haptic learning for Ss dichotomized by type of school.

Table 24 shows the final test data and F-ratios for the criterion measures and kind of school--Montessori and non Montessori.

TABLE 24

SIGNIFICANCE OF DIFFERENCES FOR MONTESSORI AND NON MONTESSORI SS IN THE FINAL TESTS IN HAPTIC LEARNING

Test	N	$\bar{x}$	σ	F	p
1					
Montessori	74	15.91	5.23	5.33	$<.05$
Non Montessori	70	13.76	5.91		
2					
Montessori	74	16.20	4.35	.44	$>.05$
Non Montessori	70	15.71	4.41		
3					
Montessori	74	17.31	4.26	6.10	$<.05$
Non Montessori	70	15.51	4.08		
4					
Montessori	74	10.96	6.46	.42	$>.05$
Non Montessori	70	10.27	6.29		
5					
Montessori	74	15.73	5.69	7.34	$<.05$
Non Montessori	70	13.13	5.90		

Ss in Montessori achieved a higher mean final score than Ss in non Montessori. However, only three obtained F-ratios (Test 1-3-5) revealed a real difference for Ss in Montessori school greater than that for Ss in the non Montessori class.

Hypothesis 13: Other things being equal mean scores for initial and final tests of haptic learning for Montessori Ss would not differ significantly.

Table 25 summarizes the results.

TABLE 25

SIGNIFICANCE OF DIFFERENCE FOR MONTESSORI SS BETWEEN MEAN SCORES IN INITIAL AND FINAL TESTS OF HAPTIC LEARNING

Test	N	$\bar{x}$	σ	F	p
1					
Initial	74	2.57	3.21	352.06	<.001
Final	74	15.91	5.23		
2					
Initial	74	8.85	6.69	62.41	<.001
Final	74	16.20	4.35		
3					
Initial	74	9.20	6.28	85.01	<.001
Final	74	17.31	4.26		
4					
Initial	74	1.59	2.30	141.61	<.001
Final	74	10.96	6.46		
5					
Initial	74	1.68	2.48	380.25	<.001
Final	74	15.73	5.69		

Each resulting F-ratio provided support that the difference between initial and final scores was highly significant. Ss in the Montessori class regardless of type of treatment achieved increments in learning as measured by the final test of haptic perception.

Hypothesis 14: Other things being equal mean scores for initial and final tests of haptic learning for non Montessori Ss would not differ significantly.

Table 26 presents the F results for non Montessori Ss when initial and final gain scores were compared.

TABLE 26

SIGNIFICANCE OF DIFFERENCE FOR NON MONTESSORI SS BETWEEN MEAN SCORES IN INITIAL AND FINAL TESTS OF HAPTIC LEARNING

Test	N	$\bar{x}$	σ	F	p
1					
Initial	70	7.10	4.90	52.412	<.001
Final	70	13.76	5.91		
2					
Initial	70	13.41	3.82	10.82	<.001
Final	70	15.71	4.41		
3					
Initial	70	14.39	4.23	2.49	<.001
Final	70	15.51	4.08		
4					
Initial	70	4.71	4.59	35.76	<.001
Final	70	10.27	6.29		
5					
Initial	70	5.76	4.47	70.22	<.001
Final	70	13.13	5.90		

Similarly, Ss in the non Montessori groups gained significantly in haptic perception since each obtained F-ratio is sufficiently large to warrant a real difference between initial and final mean gain scores.

Hypothesis 15: No significant difference in initial mean scores for haptic learning between treatment groups (experimental-control).

Table 27 presents the data related to hypothesis 15.

TABLE 27

SIGNIFICANCE OF DIFFERENCE IN MEAN INITIAL SCORES OF HAPTIC LEARNING BETWEEN EXPERIMENTAL AND CONTROL GROUPS

Test	N	$\bar{x}$	σ	F	p
1					
Experimental	96	10.10	4.87	55.65	<.001
Control	48	4.21	4.25		
2					
Experimental	96	11.59	5.76	2.19	>.05
Control	48	10.02	6.12		
3					
Experimental	96	11.91	6.03	.50	>.05
Control	48	11.19	5.70		
4					
Experimental	96	3.29	3.83	.38	>.05
Control	48	2.75	4.06		
5					
Experimental	96	3.65	4.13	.27	>.05
Control	48	3.27	4.09		

The hypothesis is tenable for four tests since the obtained F-ratios shown in Table 27 indicate a close relation in initial mean scores for Ss dichotomized by treatment. Test 1 showed a difference at .001 level favoring the Ss in experimental group. Groups were fairly well equated at beginning of study except for Test 1.

Table 28 investigates the relationship of final mean scores for Ss according to treatment.

Hypothesis 16: There is no difference in mean scores in final tests of haptic learning between treatment groups.

TABLE 28

SIGNIFICANCE OF DIFFERENCE IN MEAN SCORES IN FINAL TESTS OF HAPTIC LEARNING BETWEEN EXPERIMENTAL AND CONTROL GROUPS

Test	N	$\bar{x}$	σ	F	p
1					
Experimental	96	17.40	3.31	75.16	<.001
Control	48	9.60	5.73		
2					
Experimental	96	17.26	3.04	21.43	<.001
Control	48	13.37	5.39		
3					
Experimental	96	17.88	2.19	30.80	<.001
Control	48	13.33	5.50		
4					
Experimental	96	13.02	5.92	71.57	<.001
Control	48	5.83	4.20		
5					
Experimental	96	17.32	3.85	104.04	<.001
Control	48	8.75	5.18		

Empirical support in Table 28 indicates significant differences between types of treatment and final gain scores and rejects the hypothesis. Each F-ratio is significant and favors the experimental group.

Table 29 shows the F-test results for initial and final test scores for Ss by type of treatment.

Hypothesis 17: There is no difference in initial and final test scores for Ss in experimental-individual treatment.

TABLE 29

SIGNIFICANCE OF DIFFERENCE BETWEEN INITIAL AND FINAL MEAN SCORES IN HAPTIC LEARNING FOR Ss IN EXPERIMENTAL-INDIVIDUAL TREATMENT

Experimental-Individual	N	$\bar{x}$	σ	F	P
1					
Initial	48	4.77	4.66	210.25	$<.001$
Final	48	17.40	3.81		
2					
Initial	48	11.31	5.86	40.44	$<.001$
Final	48	17.42	3.09		
3					
Initial	48	11.35	5.85	49.98	$<.001$
Final	48	17.85	2.61		
4					
Initial	48	3.40	4.02	193.21	$<.001$
Final	48	13.00	2.61		
5					
Initial	48	3.65	4.10	292.41	$<.001$
Final	48	17.52	3.87		

Differences between initial and final mean scores for in experimental individual instruction deviate significantly from chance. Each obtained F-ratio significant beyond the .05 level presented evidence that the final mean score deviated significantly from the initial mean score.

Hypothesis 18: There is no difference in initial and final test scores for Ss in experimental-group.

Table 30 shows the F-ratios for the initial-final mean scores for Ss in experimental group treatment.

TABLE 30

SIGNIFICANCE OF DIFFERENCE BETWEEN INITIAL AND FINAL MEAN SCORES IN HAPTIC LEARNING FOR SS IN EXPERIMENTAL GROUP TREATMENT

Experimental Group	N	$\bar{x}$	σ	F	p
1					
Initial	48	5.33	5.09	213.16	<.001
Final	48	17.58	2.81		
2					
Initial	48	11.87	5.66	32.26	<.001
Final	48	17.10	2.99		
3					
Initial	48	12.48	6.21	37.21	<.001
Final	48	18.21	1.78		
4					
Initial	48	3.19	3.64	104.04	<.001
Final	48	13.04	5.65		
5					
Initial	48	4.06	4.17	259.21	<.001
Final	48	17.12	3.84		

Type of instruction whether individual or group provided final mean gain scores sufficiently different from the initial mean gain scores to be attributed to chance factors. Table 30 reports F-ratios, all significant beyond the .01 level indicating a real difference in mean scores between initial and final tests performance for Ss receiving experimental-group treatment.

Hypothesis 19: There is no parameter difference in initial tests of haptic data analyzed by experimental-individual and experimental-group treatment.

Table 31 and 32 show the F-ratios for these analyses.

TABLE 31

SIGNIFICANCE OF DIFFERENCE BETWEEN MEAN SCORES BETWEEN SS in EXPERIMENTAL INDIVIDUAL AND EXPERIMENTAL GROUP TREATMENT IN INITIAL TEST OF HAPTIC LEARNING

Test	N	$\bar{x}$	σ	F	p
1					
Exp. Individual	48	4.77	4.66	.32	>.05
Exp. Group	48	5.33	5.09		
2					
Exp. Individual	48	11.31	5.86	.22	>.05
Exp. Group	48	11.87	5.66		
3					
Exp. Individual	48	11.35	5.85	.84	>.05
Exp. Group	48	12.48	6.21		
4					
Exp. Individual	48	3.40	4.02	.072	>.05
Exp. Group	48	33.19	3.64		
5					
Exp. Individual	48	3.65	4.10	.24	>.05
Exp. Group	48	4.06	4.17		

TABLE 32

SIGNIFICANCE OF DIFFERENCE BETWEEN MEAN SCORES BETWEEN SS IN EXPERIMENTAL INDIVIDUAL AND EXPERIMENTAL-GROUP TREATMENT IN FINAL TEST OF HAPTIC LEARNING

Test	N	$\bar{x}$	σ	F	p
1					
Exp. Individual	48	17.40	3.81	.067	> .05
Exp. Group	48	17.58	2.81		
2					
Exp. Individual	48	17.42	3.09	.27	> .05
Exp. Group	48	17.10	2.99		
3					
Exp. Individual	48	17.85	2.61	.61	> .05
Exp. Group	48	18.21	1.78		
4					
Exp. Individual	48	13.00	2.61	.0016	> .05
Exp. Group	48	13.04	5.65		
5					
Exp. Individual	48	17.52	3.87	.26	> .05
Exp. Group	48	17.12	3.84		

No initial mean score when compared by type of instruction presented a significant difference. At the beginning of experiment S in both types of instruction were well equated. Similar to initial mean score data resulting F-ratios for final mean scores compared by type of instruction revealed only chance differences. Increments resulted which were very similar regardless of type of instruction. Therefore, in initial and final mean scores for haptic tests Ss evinced only chance differences when examined by type of instruction: group or individual.

A summary of F-ratios for groups by treatment appears in Appendix, p. 154.

The data in the chapter revealed results favoring experimental groups. Whether instruction was given to children individually or in a group the performance was not significantly different. Ss in a Montessori class achieved higher mean scores in the five final tests of haptic performance.

CHAPTER V

Summary and Conclusions

Psychological studies related to the work of Piaget and his co-workers concerning the growth and development of the child have been investigated by American researchers during the past two decades. One area which reported little study concerned the haptic ability of children which was explored by Piaget in quasi-experimental design. The work of Page (1959) and Fisher (1965) in England attempted to replicate Piaget's analysis.

Stemming from many centers interest in preschool education has assumed new dimensions of investigation. Funds from the Federal Government for Head Start Programs, local cities and towns, parents' groups and professional organizations have helped financially to investigate amount of curriculum planning, certification of personnel, and adequate physical facilities for the education of the young child.

There appear to be two schools of thought regarding the philosophy of early education: one emphasizing play or social activities; the other academics. Both have significant offerings for a preschool program.

Within the past decade the resurgence of a defunct method caused professional educators to question the return of the Montessori methodology. Seldom found in toto in local schools, it functions under the aegis of interested parents or groups of professionals. The word Montessori has assumed the role of a status symbol since these schools with a fairly high tuition rate cater to the children in the upper economic strata.

More important is the theoretical assumption that children attending a Montessori school showed higher achievement than their non-Montessori peers. In the literature, no data empirically derived were available to evaluate the performance of the Ss in Montessori classes.

Trained personnel conducted the experimental phase for fifteen weeks. Four schools located in the lower to higher economic levels supplied the Ss for Montessori and non Montessori groups.

The basis of the study emanated from the haptic experiment by Piaget and Inhelder. Some replication in a modified way appeared in British journals but only a meager amount of haptic study characterizes American research.

Mental ages obtained from Stanford-Binet Test of Intelligence, Form L-M, personality data related to constructiveness when faced with failure and ascendancy and pre-test of the twenty geometric forms measuring five competencies based upon a haptic presentation were available at the beginning of the experimental phase.

Therefore, 74 children, ages 3, 4, and 5 from a Montessori class and 70 children of same ages from a non Montessori class were chosen and an analysis was made of their haptic perception abilities in an experimental and non-experimental (control) situation when given instruction individually (3 lessons per week - 15 minutes each lesson) or in group (3 meetings per week - 15 minutes each lesson). Identical content was given to Ss in experimental-individual and experimental-group treatments. Control Ss received instruction from research assistants who worked with experimental groups.

The four-pronged attack answered these questions:

1. What haptic abilities do preschool children possess?
2. What effects have experimental and non-experimental treatment on haptic learning?

3. Under which instructional technique --individual or group--will children show greater achievement?
4. What difference in performance in haptic learning results with Ss from a Montessori and a non Montessori class?

Children were individually pre-tested and at the end of fifteen weeks of experimental study post-tested in five competencies involving haptic ability. All geometric corms were presented haptically and assessed the child's ability to do the following:

1. To identify geometric forms
2. To match geometric forms
3. To recognize Euclidean geometric forms in a topological presentation
4. To reproduce form graphically after haptic presentation
5. To verbalize the characteristics of the geometric form.

The five dependent or criterion variables were the gain score differentials derived from initial and final test results.

The independent variables were C. A., M. A., years in school, sex, session attended, three personality scores, and type of school.

Data were Fortran programmed and analyzed in terms of F-ratio and correlation coefficients. The .05 level indicated a significant difference between the obtained means and for the correlation coefficients.

During the experimental phase of fifteen weeks subjects within their own schools received individual or group instruction from a planned set of learning activities by five trained research assistants. A non experimental or control population received from the same instructors neutral activities as art, reading, music, organized play, etc.

Data from each principal included names, sex, dates of birth, session attended, and years in school. Mental ages from Stanford-Binet, and three personality scores completed the information prior to assigning each S to a particular block. Each instructor worked with the same Ss during the experimental phase.

The subject population was carefully and systematically randomized into experimental and control groups receiving either individual or group instruction. There was no subject attrition and where absences did occur the work was made up.

A high degree of interest was maintained throughout the study. In fact, some parents questioned why their child (in control group) was not receiving the instruction given to Ss in experimental section. To offset any teaching effects, research assistants were told to discuss the work in general terms if questioned by a teacher. Materials were kept apart from the classrooms so that they would be unavailable to children and teachers.

Various groups were well equated in C. A., and M. A., evidenced by "t" results, all of which were larger than the .05 level of probability. Results of the F-ratio significant at the .05 level was the statistic used to study the differential impact (criterion-variables) on certain independent variables and to accept or refute the hypothesis.

All hypotheses were tested by F-ratio at .05 level of probability. The following summary indicates significant findings:

1. Sex: Girls achieved higher mean scores than boys except in Test 5, where the F-ratio was not significant.
2. School: Means of gain differential scores for Ss from a Montessori school deviated significantly from those scores of the non Montessori group. These data limited by the size of the sample

(74) attest that a Montessori curriculum enriches sensorial learning related to haptic perception of spatial forms.

3. Sessions: Scores for Ss in A. M. session did not differ from scores of Ss in P. M. session.
4. Treatment: Ss who received experimental treatment differed significantly in performance from Ss who received non-experimental or control treatment.
5. Instruction: The experimental phase was dichotomized by type of instruction: individual or group. No differences resulted when mean scores from both groups were compared.
6. Previous Years in School, Mental Age and Chronological Age: Increments of previous years in school, mental age and chronological age showed no appreciable effect when compared with differential gain scores.
7. Personality Scores: No interaction resulted when personality scores were compared with gain scores.
8. A significant correlation resulted among five tests.
9. Initial testing: Scores for Ss in non Montessori school differed significantly from Ss in Montessori school.
10. Final testing: Scores for Ss in Montessori school differed significantly from Ss in non Montessori school.
11. Pre- and Post Test: Mean scores for pre- or post tests for Ss in both Montessori and non Montessori classes differed significantly. The final test data indicated a substantial gain.

A number of identifiable and measurable variables play an important part in the haptic performance of preschool children. These contribute to Bruner's dicta concerning the teachable moment and to the concern of psychologists, administrators and parents of providing some academic structure to the otherwise permissive curriculum evident in many programs of early childhood education. Within the past year, data from a Head Start Program directed by the writer indicated significant gains in readiness factors even in a short span of eight weeks. While there are unique patterns followed by teachers of the young child there is evidence from this study that planned treatment is effective.

The mode of instruction did not differ significantly for any of the groups. Children can learn in a group situation as well as in a one-to-one confrontation. The essential tasks involve children ready for a particular learning in terms of the maturation, social development and potential. Given a professionally well prepared teacher with adequate understanding of herself and of the psychology of the young child and of interview protocol within an atmosphere where there are sufficient materials and equipment for each child to experience the jobs of learning and with the semi-structured curriculum which allows for teacher initiative, enrichment, and flexibility, one has the basic ingredients for successful learning.

Some of the data in the study are used in a follow-up proposal by Sister John Vianney Coyle, S. S. as part of a doctoral dissertation. Retention is the main focus of the Coyle study.

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APPENDIX A

EVALUATION

Name ____________________

Research Assistant ____________________

School ____________________

Experimental	Mont.	Ind.	A.M.	____	Control	Mont.	Ind.	A.M.	____
			P.M.	____				P.M.	____
		Group	A.M.	____			Group	A.M.	____
			P.M.	____				P.M.	____
	Non M.	Ind.	A.M.	____		Non M.	Ind.	A.M.	____
			P.M.	____				P.M.	____
		Group	A.M.	____			Group	A.M.	____
			P.M.	____				P.M.	____

M.A.-Yr. _____ Mos. _____ C.A.-Yr. _____ Mos. _____ Sex-M ____ F ____ Yrs.in School _

Jack Score __________

Keister Score __________ __________

Address ______________________________

SCORE

	Pre-Test	Post-Test	Differential
1. Haptic Identification			
2. Haptic Matching			
3. Haptic Finding Form			
4. Haptic Reproduction			
5. Haptic Verbal Description			

	LESSON														
Times per Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1															
2															
3															

Comments:

APPENDIX B-1

Jack Test: Ascendant Behavior

1. Each child paired with six children. (10 minutes)
2. As the children came into the room the examiner said, "Here are some toys for you to play with until I come back and get your. We will keep them in the box on the table all the time. You may play with anything you want to.

Observation made apart from group by two examiners.

Scoring

1. Verbally attempts to secure materials.
2. Forcefully attempts to secure materials.
3. Succeeds in securing materials.
4. Defends, snatches materials taken from him.
5. Verbally directs behavior of companion.
6. Companion complies to his direction.
7. Forbids, criticizes, reproves companion.
8. Provides pattern of behavior which companion imitates.

Scoring: Deduction made by seconds when one of above resulted. Final score recorded in minutes.

Appendix (con't) B-2

Typical Behavioral Notations Made by Examiner

Jack: In presence of five other Ss around table S began playing with toys.

B: Watch others. No overt attempt to handle. After watching initiated initiated play with girl. Succeeded in gaining attention.

G: Tries to grab toy from other girl. Verbally directs a companion to put toy back. Complies with direction from companion to give toy to Becky.

G: Very determined to show her rights in group. Tried verbally to take materials. Snatched materials taken from her. Forcefully secures materials.

G: Tried grabbing toy but unsuccessful. Looked at other children. Joined in group activity. Imitates behavior of other.

B: "I'm not a baby. These are baby toys !" Forcefully tried to grab boat. Snatched rabbit out of girl's hand. Attempts to "show off" in group.

B: Secures material from girl. Directs verbally three girls behavior. Gives his toy to others - very happy at end - wants to share.

B: Most aggressive. Knocked toys down. Grabs from others indiscriminately. Succeeds in grabbing toys. At end begins to imitate behavior of others showing less aggression.

B: Pouting. Said he doesn't like toys. Just observed. No interaction at all.

B: Laughed and played. Held stuffed animal. Very submissive to directions from others in group.

G: Sat quietly, sucking thumb. Pushed toy away as B gave it to her. Finally started to play with B. Snatched toy - then complied to companion's request to give it back. Good interaction. All while sucking thumb.

G: Smiling - happy person. Tried to take toys from girl. Succeeded in securing materials from three in group. Imitates behavior of others.

G: Grabs at first then complies with directions. Defends her toy when another tries to snatch it away. Forcefully attempts to secure toy. Holds on to her choice - no one can touch it because it is hers.

B: = Boy
G: = Girl

Appendix (con't) B-3

Keister = Response to Failure

II. Weighted Box (10 minutes)

1. Administered individually.
2. Examiner brought child into room and pointed out the box saying, "Look_________, there are some toys under this box." The examiner lifted the box at an angle of about 90 degrees and after making sure the child had caught a glimpse of the toys, put the box down again saying, "You lift the box and take out the toys and then you may play with them."
3. During the first minute the examiner said, "You have to be strong, don't you? Keep on trying.
4. During the third minute she said, "I know it's hard but see if you can do it."
5. During the fifth minute she said, "You have to try hard if you want to get the toys out."
6. During the seventh minute she said, "If you try hard enough to get the box off, you will still have time to play with the toys."
7. At the end of the tenth minute she said, "The time is up now, ________, There's no more chance to try today. We'll leave the toys under the box."

Scoring

1. seconds = Attempt to solve along
2. seconds = No overt attempt, Indifference
   Sulks, cries, whines, etc.

Appendix (con't) B-4

Typical Observational Comments and Verbalizations of S

Weighted Box: 10 min.

Observations -

G:	0' - 4'	shows a real determination
	5' - 8'	took a rest 15" then attempts - red face - says, "I'm tired!"
	9' - 10'	extreme determination
B:	0' - 4'	"It's very heavy - like a rock." Stopped working - no attempt 35"
	5' - 8'	"Can't do it" Started examining the box about 55" - tried again
	9' - 10'	losing interest - but still trying
G:	0' - 4'	"It feels like its nailed to the wall Shows great determination
	5' - 8'	"I can't" then starts working
	9' - 10'	Continued working. Showed joy when told to stop.
B:	0' - 4'	"I can't do this! Who made this! I don't want to!".
	5' - 8'	Became mad - frowned "We need help!"
	9' - 10'	Began to such thumb - gave up -
B:	0' - 4''	Pushed box vehemently - "I can't move it!"
	5' - 8'	Began to smile "I wish my Daddy were here - even mother could do it!"
	9' - 10'	"I can't" Stopped - sat on box - gave up - at 9'
B:	0' - 4'	"I'm not strong enough" - Pushed
	5' - 8'	"Nope - I can't!"
	9' - 10'	"Hey - I can't do this! I almost did it - Began frowning pushing with no purpose.
B:	0' - 4'	Braced toes against box - "It's heavy!" Moves box around - Makes several jerking pulls - braced feet-legs against box.
	5' - 8'	"Let's see if you (E) can do it! My hands are dirty!" "I pushed it - but I can't tip it!"
	9' - 10'	"I bet you can't pick it up." Smiles gives up happily.

Keister = Response to Failure

1. Puzzle Box (10 minutes)

One child at a time. Child seated opposite examiner at low table.

1. "See ________, this little box has a lock on it and it fastens the lid down tight. I'll show you what I have in the box. (Opens box). It is all full of little toys and they are lying right down flat on the bottom of the box." (Presses hard down on toys to show that they are all lying flat. The examiner then removes the toy from the box and converses with the child about the various forms).

2. "Now _______, you put the toys back in the box just as quickly as you can, and then fasten the lid. You will have to lay them all carefully flat on the bottom or else the lid will not lock. When you get them all put away you may see the toys I have for you in this other box." (The examiner indicates a large box which was placed in full view of the child. This box contained ten small picture books, a toy airplane, a toy wagon, and a box of small toy trucks.)

3. The examiner begins timing the child from the moment he places the first block in the box.

4. During the first minute she says, "You will have to make a space for each one on the bottom of the box."

5. During the second minute she says, "You can get them all in if you try. See how quickly you can get them all laid down on the bottom of the box."

6. During the fourth minute she says, "There is a way they will all fit in. See if you can find the way."

7. During the sixth minute she says, "When you get the toys laid in and the lid locked, you will still have time to play with the toys in the other box."

8. During the eighth minute the child was warned, "The time is almost up, ________. You have only a little more time to get all the blocks in. See if you can't do it."

9. At the end of ten minutes the examiner says, "The time is up now, ________, There is no more time to try to get the blocks in."

If the child left any figures out and attempted to close the box, piled figures on top of one another, or merely sat holding a block, the examiner says, "Now you just have to find a place for _____ to go," or "Now you just have to make a space for the _______."

Scoring

1. seconds = attempts to solve along
2. seconds - no overt attempt, indifference
   sulks, cries, whines
3. converted into total seconds for recording

Puzzle: 10 minutes

B: 1' - 3' Attacks problem. Speaks not a word. Puts out tongue, showing determination.

4' - 6' "That looks like a lady's head!" Points to man's head. "I could try over again." Rearranges puzzles for 2nd time.

7' - 10' "Now I have lots of room." Big sigh. Wanted to stop. Urged to continue. Sits down. Picks up pieces and tries again,

G: 1' - 3' Settles down and works on pieces. Makes funny sounds as she works on puzzle. Tries hard to arrange pieces.

4' - 6' No try for one minute - Begins to suck thumb - Takes pieces in hand. Puts them down. Sucks thumb again.

7' - 10' Points to boat. "It does not fit." Boat only piece not in box. Tries very hard. Shakes head. Last minute no attempt. Wants to give up - Begins sucking thumb.

G: 1' - 3' "It's hard, isn't it?" Laughs. "I'll fit them. Where does this go?"

4' - 6' "This is hard! Too hard for me. This is too hard for anybody."

7' - 10' "This is flat. I can't get it in." Shakes head.

B: 1' - 3' Fits pieces together; one piece cannot go in box; tries to put it in - no success.

4' - 8' Bites ligs - Rearranges pieces - not a word spoken.

9' - 10' "There's no place for this duck - it's too fat to fit in - How can I fit it in?"

B: 1' - 3' Attacks puzzle and attempts to fit pieces in box. Puts pieces on top of each other. E tells S that no piece goes on top of another.

4' - 6' Rearranges the pieces - takes them out on table. Starts putting fingers into his mouth. Tongue begins to wag back and forth. Bites lips.

7' - 10' Sighs - Comments! "This can't be right." Points to pieces not in box. Sighs again.

G: 1' - 3' Puts each piece in carefully tries to remember where each piece beglonged.

Appendix (con't) B-7

Puzzle 10 minutes (cont'd)

G: 4' - 6' Studies box with pieces.

7' - 10' Shows excellent humor - happy to be finished.

G: 1' - 3' "All right, I'll do it." Pointing to fish - "I can't fit this one in. Stands up and rearrange pieces.

4' - 6' Speaks nothing for 2 minutes. Rearranges, fits pieces and says, "This is the only way I can do it." Looks at E.

7' - 10' "I can't do it." Has 2 pieces in hand. "Where do these go?" Pulls puzzle apart again.

B: 1' - 3' "Where's the ducky going? There's no room for the airplane. There's no more room anywhere."

4' - 6' "I have an idea. I know what I'll do." "Oh-oh-it's hard." Sits down and looks work over.

7' - 10' Rearranges pieces. "I can't do this. Do you have a bigger box where the pieces can fit?" E: "No" "Then how do you do it?" Closes lid. "Has anyone got this right?" Points to paper. "I know what's on that paper." Pounds the puzzle. "The paper tells you how to do it." "I can't do it." Pounds cover again. "It's too hard."

APPENDIX C

APPENDIX C

Observer ______

Name ______ School ______ Date ______

Keister: Weighted Box — Seconds

1. Attempts to solve alone ____
2. No overt attempt, indifferent sulks, cries, etc. ____

Total Seconds ____

Keister: Puzzle — Seconds

1. Attempts to solve alone ____
2. No overt attempt, indifferent sulks, cries, etc. ____

Total Seconds ____

Jack Test

Behavior		A	1	2	3	4	5	6
1. Verbally attempts to secure materials	1	___	___	___	___	___	___	___
2. Forcefully attempts to secure materials	2	___	___	___	___	___	___	___
3. Success in securing materials	3	___	___	___	___	___	___	___
4. Defends, snatches materials taken from him	4	___	___	___	___	___	___	___
5. Verbally directs behavior of companions	5	___	___	___	___	___	___	___
6. Companion complies with direction	6	___	___	___	___	___	___	___
7. Forbids, criticizes, reproves companions	7	___	___	___	___	___	___	___
8. Provides behavior pattern - companions imitate	8	___	___	___	___	___	___	___

Peers: A, 1–6

Comments:

APPENDIX D-1

TEACHER'S LOG (A.M.) MONTESSORI SCHOOL

Experimental-Individual and Group Treatment

Lesson 1.

Worked with lines. Followed sample lesson #1

Vocabulary added: slanted, longest, medium, shortest, top, bottom, up, down, side.

Child drew line when direction was given

Used string, clay, crayons, pencils, sticks, paper strips to reproduce lines.

Stressed that each line have 2 points.

Identification (in room) of lines.

Lesson 2.

Worked with squares. Followed sample lesson #2.

Vocabulary added: large, small, medium, up, down, side to side, rectangle

Compared square, rectangle. Traced length of sides to note sameness or difference.

Identification of squareness

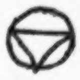
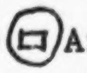
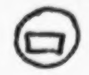
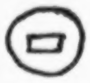
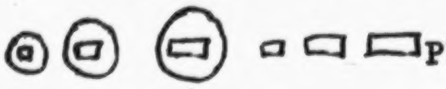
Reproduction - fairly well done

Poor control for 3 year olds, some 4's with crayons - done well with sticks

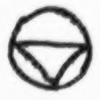
Verbal description fair

Appendix (con't) D-2

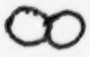
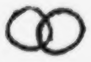
Lesson 3 con't.

Introduced Aim: to review circle, rectangle, equal and unequal sides; present  . Tools: forms of cut out paper, pencil, paper and haptic forms. Procedure: Review circle, rectangle. Place rectangle on top of 0. Play magic game of pushing rectangle inside - to get  . Traced with fingers and pencil. Drawings - poor; little coordination - even traced shapes are poor. Used Played game of "remove" - must give size, name and description of shape removed - facilitates language and recognition of shape - good.

Lesson 4.

Introduced right triangle. Aim: teach right angle in triangle. Tools: sticks, pencil and triangle. Procedure: present horizontal, vertical, slanted lines again; join horizontal and vertical lines and call it right angle. Complete triangle. Make triangle with sticks and trace on paper - no free hand drawing Review right angle. Introduce triangle. Aim: see ∟ in triangle. Procedure: pointing out right angle and calling triangle right. Used corner of square to trace shape - fair. No free hand drawing. Identification of triangle from other triangles; description - good. Evaluation: improvement in drawing. Reviewed right triangle. Introduced  aim at drawing forms and determining kind of triangle. Tools: ½0, circle, patterned paper and pencil, sticks. Procedure: Mark off ½ the circle, fit in triangle in other half. Use sticks to fit in triangle in other half. Use sticks to see if angle is right angle. Check all angles; touch 2 circles - no free hand drawing.

Lesson 5.

Introduced   Aim: to note touching and overlap of 13, 15 forms. Tools: 4 colored transparent circles, 13, 15 forms, pencil, paper. Procedure: place 2 circles on 13, 15. Trace with fingers feel, see touching, overlap. Trace on paper and match - describe - tried free hand drawing. Evaluation: All parts - good.

Reviewed acute triangles; noted 2 sides and 2 acute angles same. Measured acute and right angles on forms. Noted acute angle is smaller. Traced forms and outlined paper - fair. No attempt at free hand drawing successful.

Reviewed obtuse triangle; measured forms with acute right obtuse angles. Noted obtuse was largest angle; noted obtuse triangle had 3 different sides Traced forms and outlines of shape and marked obtuse angle. No free hand drawing

Introduced curved oval . Tools: string, stencil, pencil, forms, jewlry. Vocabulary: curved oval, long, thin. Procedure: compared circle and oval; traced forms in stencil and colored them. Felt them and traced stencil again. Used book of shapes - found ovals in pictures - traced stencil again. Identification ovals in bracelet, ring, pin; named each stone for practice in vocabulary; free hand drawing nil.

APPENDIX D-4

TEACHER'S LOG (A.M.) NON MONTESSORI SCHOOL

Experimental-Individual and Group Treatment

Lesson 1.

Constructed square with popsicle sticks, then altered angles to produce a ◇

Drew ◇ on worksheets.

Worked on drawing ◇ . Constructed ⚯ with flannelboard forms. Drew this on worksheets. Tested haptic discrimination of ⚯ and ⚭ . Some started ⏢ .

Colored rt. triangles on multifolded papers. Tested haptic recognition of triangles.

Drew ◺ . Haptic recognition of △ ◇ and other forms

Haptic discrimination of △⃝ and ▭⃝ . Colored large drawing of △⃝ .

Drew △⃝ .

Review of haptic recognition. Some drew ▭⃝ on worksheets.

Lesson 2.

Reviewed angles using strips of paper to form acute, right, and obtuse angles.

Made ⏢ with strips of paper. Drew ⏢. Some children did △⃝ or ▭⃝ on worksheets. Haptic recognition of ⏢ △⃝ ▭⃝

Reviewed △⃝ and ▭⃝ . Children who had not drawn these forms previously drew them on worksheets. For others: review of forms including haptic identification, description and drawing.

Lesson on matching. Drill on matching.

Review/haptic matching, identification and drawing.

Review, emphasizing verbal description

Review.

APPENDIX E-1

CHILD'S LOG MONTESSORI SCHOOL
W.McC.
Sample Weekly Log

Experimental-Individual

Lesson 1.

Worked on gaining rapport. Introduced straight lines. Vocabulary: straight point, line, side, top, bottom, up, down. Drawing lines - good. Used clay, string, strips, sticks - good.

Reviewed straight lines. Introduced curved lines. Used string, clay, crayons, strips, sticks. Worked on recognition and reproduction. Vocabulary: curve, longest, shortest, medium.

Slanted lines. Worked on drawing lines from corner to corner through the middle of paper. Manipulation of sticks, strips, string. Verbal explanation - fair. Made X .

Lesson 2.

Reviewed lines Introduced square. Vocabulary: up, down, side, corner, same, square. Worked on sameness of sides and corners. Used haptic forms and Montessori to Identification square - crayons to reproduce same. Game: Put assorted shapes on table. William found square and told how knew it was a square.

Worked on sameness of sides and corners of square. Used sticks to show same and different corners. Traced square and marked, measured sides, corners. Used haptic forms to feel sameness of sides, corners.

Worked on comparison of square, diamond, rectangle. Reproduction. Verbal description. Identification. Able to see size and similarities in corners, length of lines.

Lesson 3.

Reviewed lines, squares, poor reproduction of square. Looks like rectangle. Introduced O. Vocabulary: round, circle, small, medium, large. Reproduction - fair to poor; curved lines not circles. Verbal description.

Reviewed O. Worked on reproduction - traced forms - freehand on blocked paper poor control. Introduced 2 circles .

Appendix (con't) E-2

Lesson 4.

Reviewed lines, circle, square. Introduced rectangle. Worked on recognition and comparison to square. Vocabulary: rectangle, same, different, point, corner. Game: put □ ▯ in order. Description: same, different. Worked on reproduction. Traced length of sides of □ ▯ ▭. Traced printed rectangle - had tails. Free hand. Tails. Verbal description - not sure of square and rectangle.

Reviewed rectangle. Reproduction - good - no tails. Verbal description not sure of rectangle name. Wants to say triangle. Taught in class today. Used clay to make rectangle - good.

Lesson 5.

Reviewed rectangle - confuses name triangle with rectangle. Introduced . Folded paper 0 and cut in ½. Emphasized 2 half 0 equals 0. Traced 0 frame - divided in ½ and ½ - colored each ½. Identification: ½ 0 in picture book. Reviewed ⌓. Worked on reproduction. Traced printed ⌓ . Freehand ⌓ but have tails. Reviewed straight and curved lines. Identification ⌓ in stencil book.

Worked on verbal description. Difficult to understand somethings because of baby talk. Vocabulary: half, point, two, curved, straight. Games - to encourage description.

Lesson 6.

Reviewed △ . Introduced ◺◺ . Worked on recognition. Matched pairs - can't see difference in 18, 19. Used sticks to make same - 18, 19 look same. traced with pencil. ◺ ⌓

Reviewed triangles. Worked on sameness and differences in triangles - used clay to reproduce - fair - all triangles looked same. Can match forms if sees them but with eyes closed - can't.

Worked on feeling shape and telling how know what shape is in hand and with sticks making shape - poor. Can't tell differences in triangle with eyes closed.

APPENDIX E-3

CHILD'S LOG MONTESSORI SCHOOL
B.H.
Sample Weekly Log

Experimental-Individual

Lesson 1.

Introduced + X . Used lesson #10 Aim: to review lines - kinds to show that lines cross; teach horizontal and vertical and slanted. Used clay, sticks, forms, pencil, paper, arms. Procedure: Put 2 sticks together make + ; he copies. Put 2 sticks together, make X, he copies. Then make clay X + . Tried feeling shape and drawing it - no recognition at all. Repeat only guided hands. Repeat - fair. Reviewed kinds of lines then reproduced + X — |. Reviewed + X | — Vocabulary; recognition. reproduction fair to poor; can't hold the pencil. No knowledge of direction in making lines. Can only copy a line if I make one at a time. Traced forms and colored them in. Played game: Different size + + + x X X on table. Closed eyes and I removed shape. He named shape and size removed. Reversed and he removed shape while I described 1 removed.

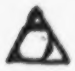
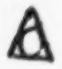
Introduced ✳ ; followed lesson #9. Aim: teach concept, formation of star. Vocabulary: star, points, six. Reproduction - poor. Can't cross lines. Combined + X for star ✳ in reproduction form - poor. Traced stars - poor Made clay stars - poor. Practiced drawing ✳ while I guided his hand - fair Drawing alone - poor.

Appendix (con't) E-4

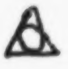
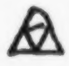
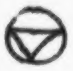
Lesson 2.

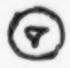
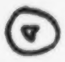
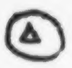
Introduced triangles. Aim: to see different kinds of triangles and angles. Tools: Montessori forms and haptic, crayons, sticks. Procedure: followed lessons 4 and 6 exactly. Identification; matching; reproduction - n.g. description.

Introduced triangle. Aim: teach triangle with 3 equal sides and angles and to recognize and reproduce it. Tools: clay, sticks, forms, pencil, paper. Procedure: Present square, triangle, compare sides, angles; triangle has 3 each. Measure sides - all same. Trace form on paper and with hands. Choose triangle from group of triangles. Used sticks to make triangle and clay. Identification and description - fine. Reproduction - nil.

Reviewed triangle - good except can't draw shape. Introduced  Aim: to teach  to understand vocabulary "circle inside triangle". Tools: forms, pencil, paper, cut paper forms. Procedure: follow lesson #12 exactly. Evaluation: can't draw shape at all but good in Identification, description, matching of forms.

Lesson 3.

Reviewed  reproduction is nil. Introduced  Aim: to teach  to recognize and form shape. Tools: crayons, forms, paper, pencil, clay. Procedure: Made circle of clay, placed triangle form in center. Noted large triangle so all angles touched circumference. Traced shape and colored in triangle - n.g. Identification; recognition; description; matching - good

Introduced  Aim: to teach , review circle, triangle, curve, cut out in vocabulary. Tools: forms, pencil, clay, paper. Procedure: feel forms, make circle of clay, insert triangle form and find  to match it. Drew pic on rexograph paper. Say cut out triangle each time. Evaluation: drawing - nil; clay and insert; description, Identification, matching - good.

APPENDIX E-5

CHILD'S LOG
B.C. (A.M.)
Sample Weekly Log

MONTESSORI SCHOOL

Experimental-Individual

Lesson 1.

Worked on gaining rapport. Introduced straight lines. Vocabulary: point, line, straight, up, down, side. Drawing lines - Made lines, sticks, paper strips, etc.

Curved lines. Reviewed straight lines. Worked on drawing and recognizing curved lines. Verbal description. Vocabulary: curve, left, right.

Used paper strips, string, clay, crayons.

Slanted lines. Drawn from corners per middle of paper. Reviewed corners, middle. Able to follow directions but poor retention. Verbal description - poor - shy.

Lesson 2.

Reviewed lines - Introduced square. Used sticks, crayons, strips, forms.

Worked on recognition, verbal description and reproduction. Vocabulary: corner, side, same, up, down.

Worked on sameness of sides and corners of square. Used different squares to see sameness of sides, corners, even though size of square changed.

Traced square - felt sameness of sides. Used haptic forms - felt sameness of sides

Reviewed square. Worked on reproduction with crayons. Vocabulary. Identification

Comparison of square and rectangle.

Lesson 3.

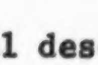
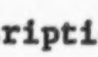
Reviewed square, lines, but reproduction had rounded curves. Introduced circle. Single line concept. Vocabulary: round, circle, large, small Reproduction - fair - corners have tails but well formed curve. Tracing. Identification good.

Reviewed circle. Worked on reproduction of circle - poor control tails, hooks, corners. Introduced 2 circles - good Traced forms - good. Worked on reproduction of circle - fair to good. Used crayon and blocked paper. Reviewed for Identification, form finding, matching and verbal description.

Lesson 4.

Reviewed lines, square, circle. Introduced rectangle. Compared with square. Vocabulary: long, short, rectangle, same, different. Used forms, sticks. Worked on reproduction, verbal description, recognition - fair, poor coordination.

Reviewed rectangle; verbal description. Worked on tracing sides of square rectangle. Compared length, similarities, differences. Tried drawing same unsuccessful - poor coordination. Traced rectangle. Made rectangle using paper strips.

Worked on verbal description and reproduction. Used printed rectangle for tracing corners and straight sides. Free hand - some difficulty making sides meet and omitting the tails, e.g.   Individual angles good. Verbal description.

Appendix (con't) E-7

Lesson 5.

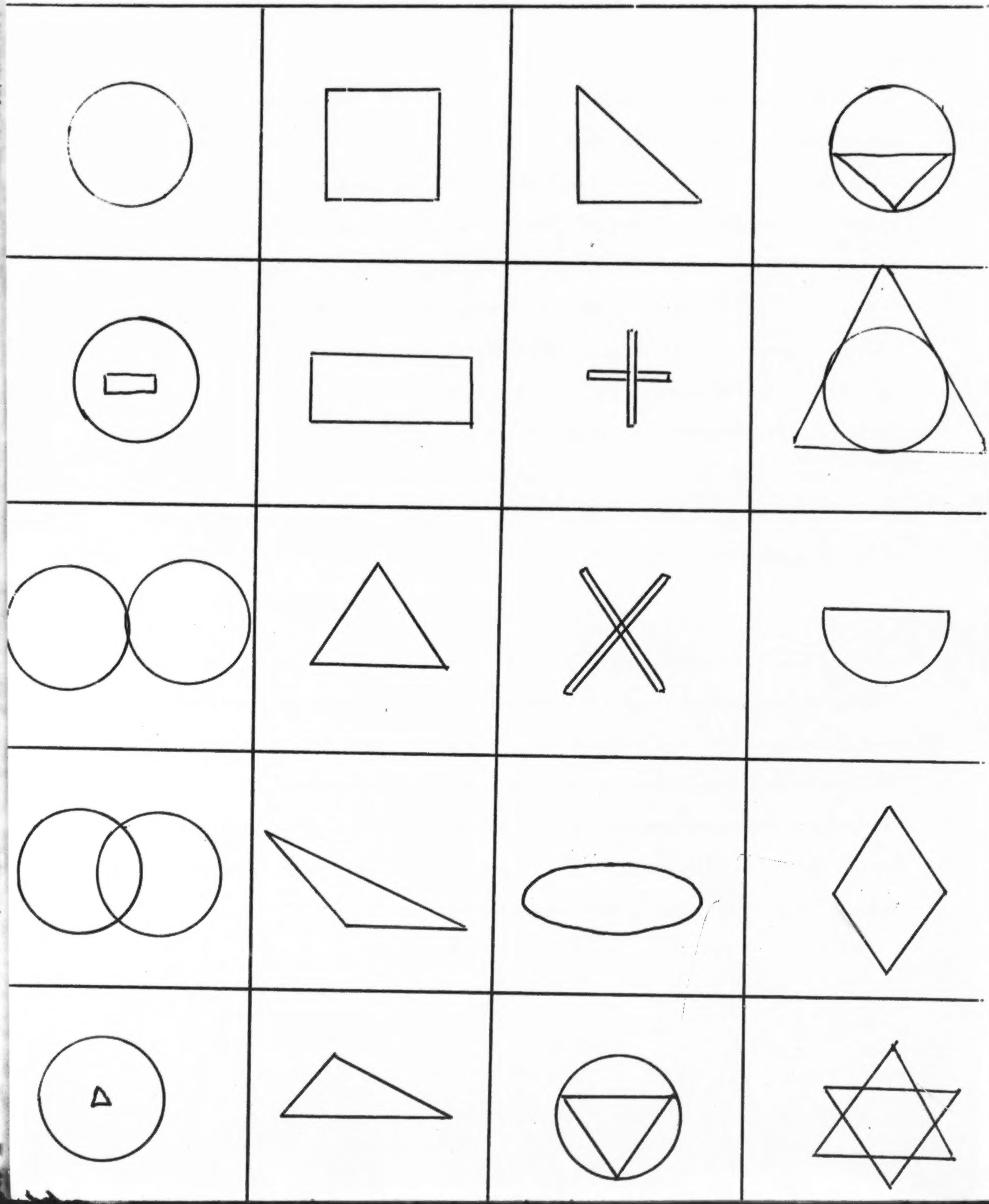
Reviewed rectangle. Introduced ◠ . Worked on recognition of basic shapes per placing ◠ on clown's face for features. Turned mouth to see direction of ◡ ◠. Called each ◠ by name and made own clown's face. Description ◠ curved line, straight line and 2 points.
Reviewed folded circles and out in ½. Colored 0 with 2 colors for each ½ .
Traced in 2" x 2" blocks - poor. No concept of shape even tracing free hand drawing - same. Traced forms. Could divide whole circle in half and color each half. Verbal description - good. Identification.
Worked on reproduction. Reviewed curved and straight lines. Put together in ½ 0 - poor - look like ovals. Worked on matching ◠ by size. Names them and description of shape. Game: What is missing? Revoved ½ ◠ from group of shapes and he describes it to return it.

Lesson 6.

Reviewed ◠ . Introduced ▷ ◁ . Worked on comparison of triangular shapes and sizes for similarities and differences. Matched triangles. Used Montessori and haptic forms to feel shapes. Used sticks to make ▷ △ .
Reviewed triangles. Worked on reproduction. Traced printed △ .
Free hand. Worked on vocabulary: sides, angles, wide, thin, triangle.
Worked on feeling different △ ▷ △ description and finding picture of same
Game: "What is missing?" Free hand drawing.

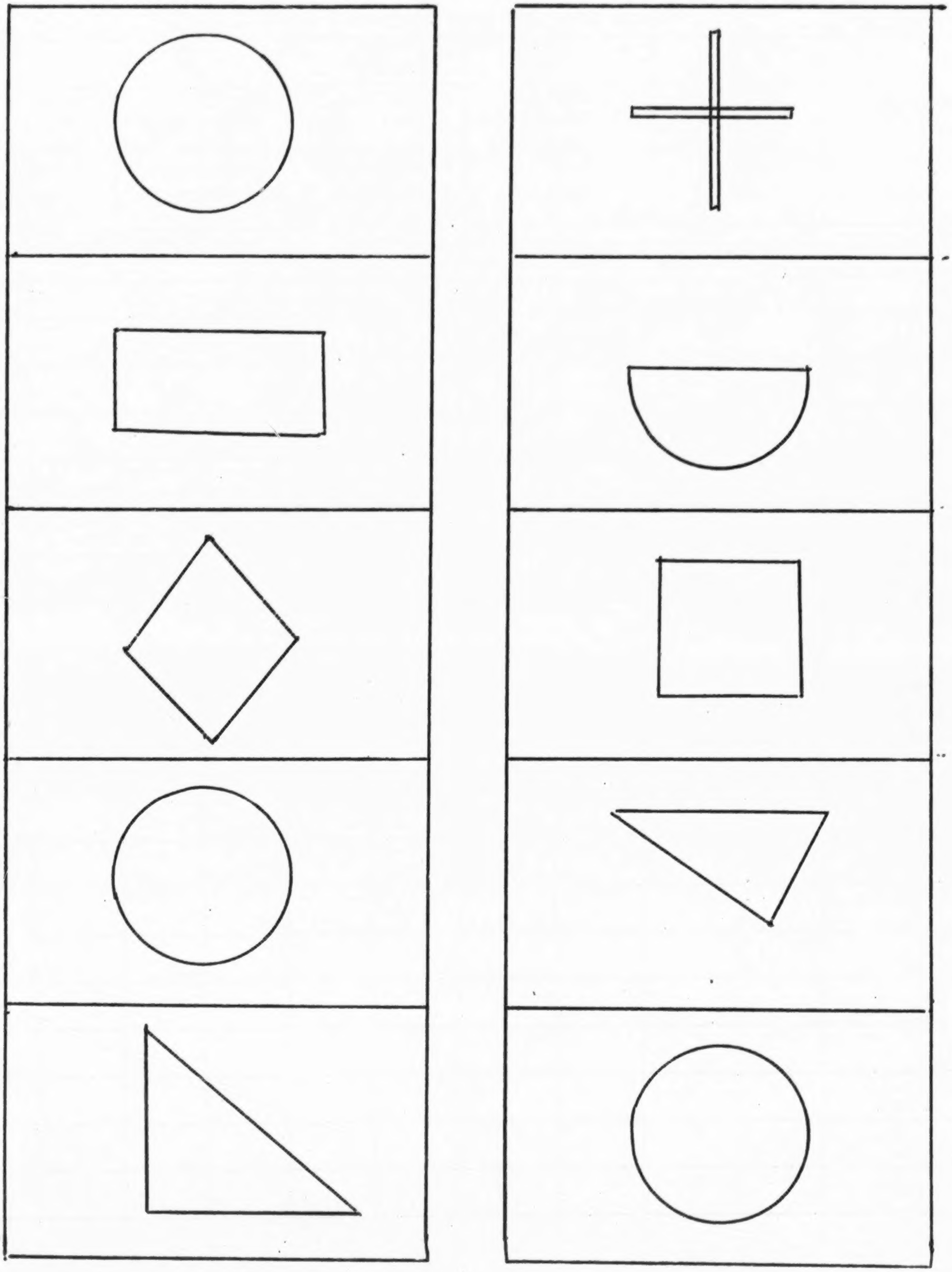
APPENDIX F

Topological Forms: Made from plyboard; one-half inch thickness, over-all size about three inches.



APPENDIX G

Twelve sets of ten cards each 3" by 10" containing five different topological forms.

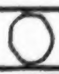
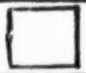
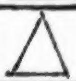
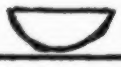
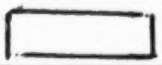
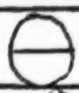
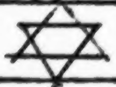
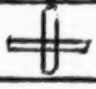
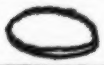
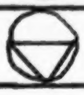
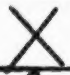
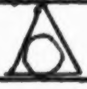
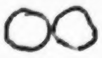
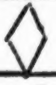
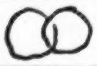
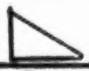
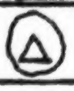
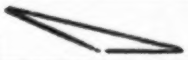
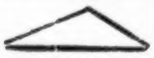
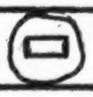


APPENDIX H

Scoring Card

Name ______________________ C. A. ______ Sex ________ Examiner ______________

Haptic Pre- and Post-Test Data Card

Geometric Form	I		II		III		IV		V	
	Haptic Identification		Haptic Identification and Matching		Haptic Identification and Finding Form on Card		Haptic Identification and Reproduction Graphically		Haptic Identification and Verbal Characteristic	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1 										
2 										
3 										
4 										
5 										
6 										
7 										
8 										
9 										
10 										
11 										
12 										
13 										
14 										
15 										
16 										
17 										
18 										
19 										
20 										

APPENDIX I

LIST OF VARIABLES USED IN STUDY

	No.	Group		No.	Group
1.	48	Experimental-Individual	16.	24	Individual A.M.
2.	48	Experimental-Group	17.	24	Individual P.M.
3.	48	Control	18.	24	Group A.M.
4.	74	Total Montessori	19.	24	Group P.M.
5.	70	Total Non Montessori	20.	24	Control A.M.
6.	72	Ss - A.M.	21.	24	Control P.M.
7.	72	Ss - P.M.	22.	23	Individual Male
8.	70	Total Male	23.	25	Individual Female
9.	74	Total Female	24.	22	Group Male
10.	24	Individual Montessori	25.	26	Group Female
11.	24	Individual Non Mont.	26.	25	Control Male
12.	25	Group Montessori	27.	23	Control Female
13.	23	Group Non Montessori	28.	38	Montessori Male
14.	25	Control Montessori	29.	36	Montessori Female
15.	23	Control Non Mont.	30.	32	Non Montessori Male
			31.	38	Non Montessori Female

APPENDIX J-1

List of Variables

X_1 = gain score on haptic recognition of geometric forms

X_2 = gain score on haptic recognition and matching of geometric forms

X_3 = gain score on haptic recognition and identification of geometric forms in a topological presentation

X_4 = gain score on haptic recognition of topological and graphically presented forms

X_5 = gain score on haptic recognition of topological forms described verbally

X_6 = 1.0 if corresponding value on X_1 is from subject with experimental individual treatment, 0 otherwise

X_7 = 1.0 if corresponding value on X_1 is from subject with group experimental treatment, 0 otherwise

X_8 = 1.0 if corresponding value on X_1 is from subject with control group, 0 otherwise

X_9 = 1.0 if corresponding value on X_1 is from subject from modified-Montessori group, 0 otherwise

X_{10}= 1.0 if corresponding value on X_1 is from subject from a non Montessori school (public school, nursery and/or kindergarten), 0 otherwise

X_{11}= 1.0 if corresponding value on X_1 is from subject in A.M. session, 0 otherwise

X_{12}= 1.0 if corresponding value on X_1 is from subject in P.M. session, 0 otherwise

X_{13}= 1.0 if corresponding value on X_1 is for a male, 0 otherwise

X_{14}= 1.0 if corresponding value on X_1 is for a female, 0 otherwise

X_{15}= $X_6.X_9$ = 1.0 if corresponding value on X_1 is for an individual experimental treatment subject in Montessori school, 0 otherwise

X_{16}= $X_6.X_{10}$= 1.0 if corresponding value on X_1 is for individual treatment subject in non Montessori school, 0 otherwise

X_{17}= $X_7.X_9$= 1.0 if corresponding value on X_1 is from group experimental treatment subject in modified Montessori school, 0 otherwise

X_{18}= $X_7.X_{10}$=1.0 if corresponding value on X_1 is from group experimental treatment in non Montessori school, 0 otherwise

$X_{19} = X_8.X_9 = 1.0$ if corresponding value on X_1 is from control treatment subject in modified Montessori school, 0 otherwise

$X_{20} = X_8.X_{10} = 1.0$ if corresponding value on X_1 is from control treatment subject in non Montessori school, 0 otherwise

$X_{21} = X_6.X_{11} = 1.0$ if corresponding value on X_1 is from individual experimental treatment subject in A.M. session, 0 otherwise

$X_{22} = X_6.X_{12} = 1.0$ if corresponding value on X_1 is from individual experimental treatment subject in P.M. session, 0 otherwise

$X_{23} = X_7 1 X_{11} = 1.0$ if corresponding value on X_1 is from group experimental treatment subject in A.M. session, 0 otherwise

$X_{24} = X_7.X_{12} = 1.0$ if corresponding value on X_1 is from group experimental treatment subject in P.M. session, 0 otherwise

$X_{25} = X_8.X_{11} = 1.0$ if corresponding value on X_1 is from control treatment subject in A.M. session, 0 otherwise

$X_{26} = X_8.X_{12} = 1.0$ if corresponding value on X_1 is from control treatment subject in P.M. session, 0 otherwise

$X_{27} = X_6.X_{13} = 1.0$ if corresponding value on X_1 is from individual experimental treatment male subject, 0 otherwise

$X_{28} = X_6.X_{14} = 1.0$ if corresponding value on X_1 is from individual experimental treatment female subject, 0 otherwise

$X_{29} = X_7.X_{13} = 1.0$ if corresponding value on X_1 is from group experimental treatment male subject, 0 otherwise

$X_{30} = X_7.X_{14} = 1.0$ if corresponding value on X_1 is from group experimental treatment female subject, 0 otherwise

$X31 = X_8.X_{13} = 1.0$ if corresponding value on X_1 is from control treatment male subject, 0 otherwise

$X_{32} = X_8.X_{14} = 1.0$ if corresponding value on X_1 is from control treatment female subject, 0 otherwise

$X_{33} = X_9.X_{13} = 1.0$ if corresponding value on X_1 is from male subject in modified Montessori school, 0 otherwise

$X_{34} = X_9.X_{14} = 1.0$ if corresponding value on X_1 is from female subject in modified Montessori school, 0 otherwise

$X_{35} = X_{10}.X_{13} = 1.0$ if corresponding value on X_1 is from male subject in non Montessori school, 0 otherwise

$X_{36} = X_{10}.X_{14} = 1.0$ if corresponding value on X_1 is from female subject in non Montessori school, 0 otherwise

Appendix (con't) J-3

X_{37} = mental age

X_{38} = chronological age

X_{39} = previous years in modified Montessori or non Montessori class

X_{40} = ascendancy personality score

X_{41} = constructiveness in failure personality score

X_{42} = constructiveness in failure personality score

The models in this series are shown below:

1. Criterion X_1; independent variables X_6 through X_{41}
2. Criterion X_1; independent variables X_6 through X_{14} and X_{21} through X_{41}
3. Criterion X_1; independent variables X_6 through X_{20} and X_{27} through X_{41}
4. Criterion X_1; independent variables X_6 through X_{26} and X_{33} through X_{41}
5. Criterion X_1; independent variables X_6 through X_{32} and X_{37} through X_{41}
6. Criterion X_1; independent variables X_6 through X_{14} and X_{33} through X_{41}
7. Criterion X_1; independent variables X_9 through X_{14} and X_{33} through X_{41}
8. Criterion X_1; independent variables X_6 through X_{14} and X_{21} through X_{32} and X_{37} through X_{41}
9. Criterion X_1; independent variables X_6 through X_8 and X_{11} through X_{14} and X_{21} through X_{32} and X_{37} through X_{41}
10. Criterion X_1; independent variables X_6 through X_{20} and X_{27} through X_{41}
11. Criterion X_1; independent variables X_6 through X_{10} and X_{13} through X_{20} and X_{27} through X_{41}
12. Criterion X_1; independent variables X_6 through X_{26} and X_{37} through X_{41}
13. Criterion X_1; independent variables X_6 through X_{12} and X_{15} through X_{26} and X_{37} through X_{41}
14. Criterion X_1; independent variables X_6 through X_{36} and X_{38} through X_{41}
15. Criterion X_1; independent variables X_6 through X_{37} and X_{39} through X_{41}
16. Criterion X_1; independent variables X_6 through X_{38} and X_{40} through X_{41}
17. Criterion X_1; independent variables X_6 through X_{39} and X_{42}
18. Criterion X_1; independent variables X_6 through X_{40}

APPENDIX K

Source Models

1. Experimental condition by type school interaction; 1, 2
2. Experimental condition by session interaction; 1, 3
3. Experimental condition by sex interaction; 1, 4
4. Type of school by sex interaction; 1, 5
5. Experimental condition main effect; 6, 7
6. Type of school main effect; 8, 9
7. Session main effect; 10, 11
8. Sex main effect; 12, 13
9. Regression on M.A.; 1, 14
10. Regression on C.A.; 1, 15
11. Regression on years in school; 1, 16
12. Regression on ascendancy; 1, 17
13. Regression on constructiveness to failure; 1, 18

APPENDIX L-1

DESCRIPTIONS OF SUBROUTINES PERSUB REFERENCE MANUAL

CDTOTP (IDTAPE, NR, NC, LBUFF, HOLLER)

CARD TO TAPE

REQUIRES POSTAP, EXIT

READS A MATRIX OF NR ROWS AND NC COLUMNS FROM CARDS ONTO TAPE IDTAPE WHERE IDTAPE = 1,2,3..., 49 AS ESTABLISHED ON THE INPUT/OUTPUT LIST OF THE MCS CONTROL CARD.
A FORMAT SPECIFICATION MUST PRECEED THE INPUT DECK AS DESCRIBED IN CDTOCR. THE MATRIX IS STORED BY ROWS, AND EACH ROW IS IN A SEPARATE RECORD. THE DATA ARE STORED AS DESCRIBED ABOVE UNDER - TAPES -. THE ROWS WILL BE STORED IN BINARY RECORDS UNLESS A BLANK CARD IS USED AS A FORMAT CARD. IN THIS CASE BCD 80 COLUMN CARD IMAGES WILL BESTORED IN EACH RECORD. LBUFF IS THE BEGINNING LOCATION IN THE A VECTOR OF A WORK AREA, WHICH MUST CONTAIN AT LEAST NC LOCATIONS, USED BY THE SUBROUTINE. ARGUMENT HOLLER MUST CONTAIN AT LEAST 8 HOLLERITH CHARACTERS. THESE ARE USED AS A FILE DESIGNATOR WHEN THE FILE IS BEING REFERENCED. EACH FILE DESCRIPTION SHOULD BE UNIQUE.

```
C   CDTOTP
C   CARD TO TAPE STORES NRXNC ARRAY   ON TAPE BY ROWS
    SUBROUTINE CDTOTP (LDTAPE, NR, NC, LBUFF, HOLLER)
    DIMENTION FMT1 (22), KFM1 (22), FMT2 (22), KFMT2 (22), A (1), KA (1)
    COMMON FMT1, FMT2, A
    EQUIVALENCE (FMT1, KFMT1), (FMT2, KFMT2), (A, KA)
    CALL POSTAP (LOCREC, IDTAPE, 999999999, Holler)
 11 KOUNT = LOCREC
 12 LEND  = LBUFF  -1 + NC
 13 IRECRD = 1
 20 Read 21, (FMT1 (I),  1 = 1, 11)
 21 FORMAT (9A8, A6, 1X, F1.0)
 30 IF (FMT1 (11))40, 46, 40
 40 READ 21, (FMT1 (I), I - 12, 18)
 41 DIFF = 1.
 42 GOR TO 63
 46 DIFF = (FMT1 (1) -FMT1 (2) )
 47 IF (DIFF) 63, 48, 63
 48 LEND = LBUFF + 9
 51 IRECRD = 0
 63 WRITE (IDTAPE) KOUNT, IRECRD, NR, NC, HOLLER
 90 DO 150  I = 1, NR
100 KOUNT = LOCREC + I
    IF (DIFF) 105, 110, 105
105 READ FMT1, (A (J), J = LBUFF, LEND)
    GO TO 115
110 READ 999, (A (J), J = LBUFF, LEND)
115 IF (DIFF) 140, 120, 140
120 WRITE (IDTAPE, 9999) KOUNT, (A (J), J = LBUFF, LEND)
```

```
 130 GO TO 150
 140 WRITE (IDTAPE) KOUNT, (A (J), J = LBUFF, LEND)
 150 CONTINUE
 160 KOUNT = LOCREC + NR + 1
 170 I = 999999999
 180 WRITE (IDTAPE) I, KOUNT
 190 REWIND IDTAPE
 999 FORMAT (10A8)
9999 FORMAT (19, 10A8)
 200 RETURN
 210 END
```

TPTOTP (LDFRTP, FRFILE, NR, NFRCOL, LFRBUF, IDTOTP, TOFILE,
NTOCOL, LTOBUF, IDFMT)

TAPE TO TAPE

REQUIRES DATRAN, POSTAP, EXIT, ZEROST, MOVCOR.

COPIES THE MATRIX CALLED -FRFILE- OF -NR- ROWS AND -NFRCOL- COLUMNS FROM TAPE -IDFRTP- TO TAPE -IDTOTP- AS THE MATRIX NAMED -TOFILE- WITH -NR- ROWS AND -NTOCOL- COLUMNS. -FRFILE- IS THE 8 CHARACTER NAME OF THE FROM FILE. -FRFILE- IS READ INTO THE -LFRBUF- BUFFER AND IS TRANSFERRED TO THE -LTOBUF- BY SUBROUTINE DATRAN. THE -LTOBUF- IS WRITTEN AS THE -TOFILE-. THE STANDARD DATRAN ROUTINE IS A ONE-TO-ONE MOVEMENT.

IF THE FROM FILE WAS WRITTEN BINARY, -IDFMT- IS DISREGARDED. IF THE FROM FILE WAS WRITTEN BCD, -IDFMT- HAS THE FOLLOWING MEANING
0 - 80 CHARACTER CARD IMAGE FORMAT USED FOR BOTH FROM AND TO FILES.
1 - THE CURRENT CONTENTS OF FMT1 ARE USED TO READ THE FROM FILE. THE TO FILE IS WRITTEN BINARY.
2 - THE FROM FORMAT IS TO BE READ FROM CARDS. SEE TPTOCR. THE TO FILE IS WRITTEN BINARY.

```
C     TPTOTP
      SUBROUTINE TPTOTP (IDFRTP, FRFILE, NR, NFRCOL, LFRBUF, IDTOTP,
    1 TO FILE, NTOCOL, LTOBUF, IDFMT)
      DIMENSION FMT1 (22), KFMT1 (22), FMT2 (22), KFMT2 (22), A (1), KA (1)
      COMMON FMT1, FMT2, A
      EQUIVALENCE (FMT1, KFMT1), (FMT2, KFMT2), (A, KA)
   10 CALL POSTAP (KOUNT, IDFRTP, 0, FRFILE)
   20 CALL POSTAP (KOUNT, IDTOTP, 999999999, TO FILE)
   30 BACKSPACE IDFRTP
   35 READ (IDFRTP) I, ITYPE
   40 IRECRD = -KOUNT
      IF (ITYPE) 54, 51, 54
   51 IF (IDFMT) 54, 52, 54
   52 ITYPO = 0
      GO TO 90
   54 ITYPO = 1
```

```
  90 WRITE (IDTOTP) IRECRD, ITYPO, NR, NTOCOL, TOFILE
 100 IF (ITYPE) 200, 101, 200
 101 IF (IDFMT) 102, 200, 102
 102 GO TO (200,110), IDFMT
 110 READ 111, (FMT1 (I), I = 1, 11)
 111 FORMAT (9A8, A6, 1X, F1.0)
 112 IF (FMT1 (11) ) 113, 200, 113
 113 READ 111, (FMT1 (I), I = 12, 18)
 200 DO 320  I = 1, NR
 210 KOUNT = KOUNT + 1
 220 KTO = LFRBUF - 1 + NFRCOL
 230 KTO 2 = LTOBUF - 1 + NTOCOL
 240 IF (ITYPE) 270, 245, 270
 245 IF (IDFMT) 250, 246, 250
 246 READ (IDFRTP, 999) (A (J), J = LFRBUF, KTO)
     GO TO 280
 250 READ (IDFRTP, FMT1) (A (J), J = LFRBUF, KTO)
     GO TO 280
 270 READ (IDFRTP) K, (A (J), J = LFRBUF, KTO)
 280 CALL DATRAN (LFRBUF - 1, NFRCOL, LTOBUF -1, NTOCOL)
 290 IF (ITYPO) 315, 300, 315
 300 WRITE (IDTOTP, 9999) FOUNT, (A (J), J = LTOBUF, KTO2)
 310 GO TO 320
 315 WRITE (IDTOTP) KOUNT, (A (J)), J = LTOBUF, KTO2)
 320 CONTINUE
 330 KOUNT = KOUNT + 1
 340 K = 999999999
 350 WRITE (IDTOTP) K, KOUNT
 360 REWIND IDFRTP
 370 REWIND IDTOTP
9999 FORMAT (I9,10A8)
 999 FORMAT (9X, 10A8)
 380 RETURN
 390 END
```

DATRAN (I,NFRCOL, J, NTOCOL)

DATA TRANSFORMATION

REQUIRES ZEROST, MOVCOR

THIS SUBROUTINE IS CALLED WITHIN THE TPTOTP SUBROUTINE TO TRANSFORM EACH RECORD AS IT MOVES FROM ONE TAPE TO ANOTHER.
THE STANDARD LIBRARY SUBROUTINE MOVES NFRCOL WORDS STARTING IN LOCATION A (I+1) TO STORAGE BEGINNING IN A (J+1).
HOWEVER, THE USER CAN WRITE ANY DATRAN SUBROUTINE THAT IS REQUIRED FOR A PARTICULAR TRANSFORMATION OF DATA. THE USER-S DATRAN SUBROUTINE WILL TAKE PRECEDENCE OVER THE STANDARD LIBRARY VERSION OF DATRAN.
THE EXAMPLE BELOW IS A POSSIBLE NON-STANDARD DATRAN SUBROUTINE.

```
C     DATRAN EXAMPLE FOR PERSUB MANUAL
      SUBROUTINE DATRAN (I, NFRCOL, J, NTOCOL)
   10 CALL ZEROST (J + 1, 1, NTOCOL)
   20 CALL MAVCOR (I + 1, 1, NFRCOL, J + 1)
   30 A (J + 5) = A (I + 1) *A (I + 1)
   40 A (J + 6) = A (I + 1) *A (I + 6)
   50 A (J + 9) = SQRT (A (I + 5) )
   60 IF (A (I + 3 ) -2.0) 80, 80, 70
   70 A (J + 10 ) = 1.0
   80 A (J + 15)  = A (I + 7) **1.2
   90 IF (A (I + 7) -3.0) 120, 100, 100
  100 IF (8.0 - A (I + 7) ) 120, 110, 110
  110 A (J + 20) = 1.0
  120 A (J + 30) = A (I + 25) **5
      RETURN
      END
```

```
   DATRAN
   TRANSFORMS DATA MOVING FROM TPTOTP
   SUBROUTINE DATRAN (I, NFRCOL, J, NTOCOL)
   DIMENSION FMT1 (22), KFMT1 (22), FMT2 (22), KFMT2 (22), A (1), KA (1)
   COMMON FMT1, FMT2, A
   EQUIVALENCE (FMT1, KFMT1), (FMT2, KFMT2), (A, KA)
   CALL ZEROST (J + 1, 1, NTOCOL)
10 CALL MOVCOR (I + 1, 1, NFRCOL, J + 1)
20 RETURN
30 END
```

```
CORRLB (IDTAPE, FILE, NUM, NVAR, LMEAN, LSIGMA, LCORR)

        CORRELATION MATRIX -- MODEL B

        REQUIRES POSTAP, ZEROST, EXIT

        COMPUTES MEANS, STANDARD DEVIATIONS, AND CORRELATIONS
        FOR THE NVAR VARIABLES USING NUM OBSERVATIONS.  THE
        DATA IS DESIGNATED AS FILE AND IS SPECIFIED BY A
        DEQUENCE OF 8 HOLLERITH CHARACTERS.  THESE MAY BE
        THE SAME AS THE FIRST 8 CHARACTERS OF ARGUMENT -HOLLER-
        USED BY CDTOTP OR CRTOTP IN PLACING THIS DATA ON TAPE.
        THE FILE MUST BE ON TAPE IDTAPE.  THE NVAR BY NVAR CORRELA-
        TION MATRIX WILL BE STORED BEGINNING IN A (LCORR).
        THE NVAR MEANS BEGIN IN A (LMEAN).  THE NVAR STANDARD
        DEVIATIONS BEGIN IN A (LSIGMA).
        FOR EXAMPLE
           CALL CORRLB (2, 8HDATANUM1, 1500, 50, 1, 51, 101)
           WILL RESULT IN
           (1) A SEARCH MADE ON TAPE 2 FOR THE FILE DATANUM 1
           (2) COMPUTATION OF MEANS, STANDARD DEVIATIONS,
               AND CORRELATIONS FOR THE 50 VARIABLES USING
               1500 OBSERVATIONS.  THE MEANS ARE IN A (1)...A (50),
               STANDARD DEVIATIONS ARE IN A (51)...A (100), THE
               SQUARE MATRIX OF CORRELATIONS ARE IN A (101)...A (2600).
```

```
C     CORRLB
C     MEANS, STANDARD DEVIATIONS, CORRELATIONS
C     USES SIGMA AS BUFFER FROM TAPE
      SUBROUTINE CORRLB (IDTAPE, FILE, NUM, NVAR, LMEAN, LSIGMA, LCORR)
      DIMENSION FMT1 (22), KFMT1 (22), FMT2 (22), KFMT2 (22), A (1), KA (1)
      COMMON FMT1, FMT2, A
      EQUIVALENCE (FMT1, KFMT1), (FMT2, KFMT2), (A, KA)
   20 CALL ZEROST (LCORR, NVAR, NVAR)
   21 CALL ZEROST (LMEAN, NVAR, 1)
   22 CALL ZEROST (LSIGMA, NVAR, 1)
   23 CALL POSTAP (LOCREC, IDTAPE, 0, FILE)
   30 DO    74 I = 1, NUM
   40 ITO = LSIGMA + NVAR - 1
   41 READ (IDTAPE) LOCT, (A (II), II = LSIGMA, I TO)
   51 DO    74 J = 1, NVAR
      IA = LSIGMA = 1 + J
   60 IT = LMEAN - 1 + J
   61 A (IT) = A (IT) + A (IA)
   70 DO    74 L = J, NVAR
      IB = LSIGMA = 1 + L
   71 IT = (LCORR - 1) + ( (L-1) *NVAR) + J
   72 A (IT) = A (IT) + A (IA *A (IB)
   73 ITR = (LCORR -1) + ( (J-1) *NVAR) + L
   74 A (ITR) = A  (IT)
   75 REWIND IDTAPE
C     COMPUTE R MATRIX
   78 CALL ZEROST (LSIGMA, NVAR, 1)
   80 FN = NUM
C     COMPUTE NON DIAGONAL ELEMENTS OF R MATRIX
      KM1 = NVAR -1
   81 DO 130 I = 1, KM 1
   82 IP1 = I + 1
   83 DO 130 J = I
   84 ISI = LCORR -1 + (I-1) *NVAR + I
   85 ISJ = LCORR -1 + (J-1) *NVAR + J
   86 ISIJ = LCORR -1 + (J-L)*NVAR + I
   87 ISJI = LCORR -1 + (I-1)*NVAR + J
   88 IMI = LMEAN -1 + I
   89 IMJ = LMEAN -1 + J
   90 DEN = SQRTF ( (FN* A (ISI) -A (IMI) *A (IMI) )  *(FN*A (ISJ) -A (IMJ) *A (IMJ) ) )
   95 IF (DEN) 110, 100, 110
  100 A (ISIJ) = 0.0
  105 GO TO 130
  110 A (ISIJ) = (FN*A (ISIJ) -A IMI) *A (IMJ) )/DEN
  115 IF (ABSF (A (ISIJ) ) -1.0) 130, 130, 120
  120 Print 125, I, K, A (ISIJ)
  125 FORMAT (28H OUT OF RANGE CORRELATION I=15, 5H  J=15,5H   R=F10.4)
  126 CALL EXIT
  130 A (ISJI) =A (ISIJ)
C     COMPUTE MEAN AND SIGMA
  135 DO  165 I=1, NVAR
  140 IM =LMEAN -1 + I
  145 A (IM) =A (IM)/FN
  150 IS=LSIGMA -1 + I
  155 II = LCORR -1 + (I=1) *NVAR + I
  160 A (IS) = SQRTF ( (A (II)/FN) -A (IM) *A (IM) )
C     COMPUTE DIAGONAL ELEMENTS OF R MATRIX
  161 IF (A (IS) ) 162, 162, 164
  162 A (II) = 0.0
  163 GO TO 165
  164 A (II) = 1.0
  165 CONTINUE
  170 RETURN
```

REGRED (LMEAN, LSIGMA, LCORR, LSTDWT, LWTS, LRSQ, NVAR)

ITERATIVE REGRESSION

REQUIRES ZEROST, EXIT

THIS ROUTINE IS IDENTICAL TO REGREB EXCEPT FOR THE FOLLOWING POINTS.

1. THE ITERATION IS NOT PRINTED
2. RETURN IS NOT AUTOMATIC BUT IS ACCOMPLISHED BY ENCOUNTERING A BLANK MODEL CARD.
3. IF K MODEL CARDS ARE ENCOUNTERED BEFORE A BLANK, K RSQ WILL BE STORED BEGINNING AT A (LRSQ)
4. THE MODEL CARD DOES NOT SPECIFY A STOP CRITERION AND THE FIELDS FOLLOWING COLUMN 10 ARE 3 DIGIT FIELDS.
5. IF THE NUMBER OF FIELDS IS FOUR (4) AN F-RATIO IS COMPUTED USING FIELDS 1-4 WHICH SHOULD CONTAIN
    - FIELD 1 - RSQ. NO. OF FULL MODEL
    - FIELD 2 - RSQ. NO. OF RESTRICTED MODEL
    - FIELD 3 - DF FOR NUMERATOR
    - FIELD 4 - DF FOR DENOMINATOR

```
C       REGRED
        ITERATIVE REGRESSION
        SUBROUTINE REGRED (LMEAN, LSIGMA, LCORR, LSTDWT, LWTS, LRSQ, NVAR)
        DIMENSION FMT1 (22), KFMT1 (22), FMT2 (22), KFMT2 (22), A (1), KA (1)
        COMMON FMT1, FMT2, A
        EQUIVALENCE (FMT1, KFMT1), (FMT2, KFMT2), (A, KA)
        DIMENSION MFLD (30), MFLDL (15)
        K6 = 0
   31   READ 32, (FMT1 (J), J=14, 15), NFLDS, (MFLD (I), I=1, NFLDS)
   32   FORMAT (2A5, 2313 / (2613))
        IF (NFLDS) 35, 35, 36
   35   RETURN
   36   IF (NFLDS-4) 37, 400, 37
   37   K5 = NFLDS -1
   38   IDC = MFLD (NFLDS)
   39   STOPC = .00001
   40   PRINT 41, (FMT1 (J), J = 14, 15), STOPC, IDC, (MFLD (I(, I = 1, K5)
   41   FORMAT (///2x, 5H.....2A5, F10.6/12H  CRITERION I5/12H  PREDICTORS 16,
        12H -14/ (12X, 16, 2H -14))
  120   NFLD1 = NFLDS -1
  130   DO   160 I = 2, NFLD1, 2
  140   M = I/2
  150   MFLDL (M) = MFLD (I)
  160   MFLD (M)  = MFLD (I - 1 )
C       INITIALIZE
  170   CALL ZEROST (LWTS, NVAR, 1)
  180   CALL ZEROST (LSTDWT, NVAR, 1)
  190   S = 0.0
  200   SIG2 = 0.0
  201   RSQ  = 0.0
  202   DEL  = 0.0
  210   ITER = 0
  211   ID   = 1
  212   NGRP = NFLDS/2
```

```
C  213  SET FOR NEW ITERATION
   220  RSQL = 0.0
   230  DO  255  I = 1, NGRP
C  221  ITERATE
   231  KSTAR = MFLD (I)
   232  KSTOP = MFLDL (I)
   233  DO   255  J= KSTAR, KSTOP
   234  IA = (LWTS - 1) + J
   235  IB = ( (J-1) *NVAR + ID + LCORR -1
   236  IC = ( (J-1) *NVAR + IDC + LCORR -1
   237  A (IA) = A (IA) + (DEL *A((IB) )
   238  DEN = S - (A (IA) *A (IC) )
   239  IF (DEN) 245, 240, 245
   240  DELT = A (IC)
   241  STEST = DELT * DELT
   242  SIG2T = STEST
   243  RSQT = STEST
   244  GO  TO 249
   245  DELT = ( (SIG2 *A (IC) ) - (S *A (IA) ) ) /DEN
   246  STEST = S + (DELT *A (IC) )
   247  SIG2T = SIG2 + (2.0 *A (IA) *DELT) + (DELT * DELT)
   248  RSQT  = (STEST * STEST) / SIG2T
   249  IF (RSQL - RSQT) 250, 255, 255
   250  SLAR = STEST
   251  SIG2L = SIG2T
   252  RSQL = RSQT
   253  DELTL = DELT
   254  IDLAR = J
   255  CONTINUE
  1255  IF (RSQL - RSQ - STOPC) 268, 256, 256
   256  S = SLAR
   257  SIG2 = SIG2L
   258  RSQ = RSQL
   259  DEL = DELTL
   260  ITER = ITER + 1
   261  ID = IDLAR
   262  IA = (LSTDWT - 1 ) + ID
   263  A (IA) = A (IA) + DEL
  1265  IF (RSQ - 1.01) 220, 220, 1266
  1266  PRINT 1267
  1267  FORMAT (25H RSQ IS GREATER THAN ONE.)
  1269  CALL EXIT
C  267  TERMINATE
   268  SDS2=S/SIG2
  1268  PRINT 265, RSQL, ITER
   265  FORMAT ( //5X, 5HRSQ. = F11.8, 40X, 15)
   269  DO  274  I = 1, NGRP
   270  KSTAR = MFLD (I)
   271  KSTOP = MFLD (I)
   272  DO  274 J = KSTAR, KSTOP
   273  IA = LSTDWT - 1 + J
   274  A (IA) = A (IA) *SDS2
   275  PRINT 276
   276  FORMAT (///)
   277  PRINT 278
   278  FORMAT (34H  VAR. NUMBER  STD. WT.   ERROR//)
   279  DO  295 I = 1, NGRP
   280  KSTAR = MFLD (I)
  281  KSTOP = MFLDL (I)
  282  DO 295 J = KSTAR, KSTOP
  283  IA = LWTS -1 + J
  284  A (IA) = 0.0
  285  DO  291  IL = 1, NGRP
  286  LSTAR = MFLD (IL)
  287  LSTOP = MFLDL (IL)
  288  DO  291 L=LSTAR, LSTOP
  289  IB = LSTDWT -1 + L
  290  IC = ( (J-1) *NVAR) + L + LCORR -1
  291  A (IA) = A (IA) + (A (IB) * A (IC) )
  292  IC = ( (J-1) *NVAR) + IDC + LCORR -1
  293  A (IA) =A (IA) -A (IC)
  294  IB = LSTDWT -1 + J
  295  PRINT 296, J, A (IB), A (IA)
  296  FORMAT (1H I10, F15, 8, F15.8)
C 297  COMPUTE REGRESSION EQUATION
  298  PRINT 299
  299  FORMAT (/////25H  VAR.  NUMBER    WEIGHT //)
  300  FK1 = 0.0
  301  DO  315 I = 1, NGRP
  302  KSTAR = MFLD (I)
  303  KSTOP = MFLDL (I)
  304  DO  315  J =KSTAR, KSTOP
  305  IA = LSIGMA -1 + J
  306  IB = LSTDWT -1 + J
  307  IC = LSIGMA -1 + IDC
  308  ID = LMEAN -1 + J
  309  IE = LWTS -1 + J
  310  IF (A (IA) ) 313, 311, 313
  311  A (IE) = 0.0
  312  GO TO 315
  313  A (IE) = A (IB) * (A (IC) /A (IA) )
  314  FK1 = FK1 + (A (IB) * (A (ID) / A (IA) ) )
  315  PRINT 316, J, A (IE)
  316  FORMAT (1H 19, F 18.8)
  317  ID = LMEAN -1 + IDC
  318  REGCO=A (ID) - (A (IC) *FK1)
  321  PRINT  330, REGCO
  330  FORMAT  (/10H CONSTANT = F18.8)
  323  LAPN = LWTS + NVAR
  324  A (LAPN) = REGCO
 1324  A (LRSQ + K6) = RSQL
 2324  K6 = K6 + 1
 3324  GO TO 31
  400  DF1 = MFLD (3)
  401  DF2 = MFLD (4)
  402  K8 =  MFLD (1) -1 + LRSQ
  403  K9 +  MFLD (2) -1 + LRSQ
  404  F=( (A (     K8) -A (     K9) ) /DF1) ( (1.0-A  (     K8) ) /DF2)
  405  PRINT 406, F, DF1, DF2, MFLD (1), A (      K8), MFLD (2), A (      K9)
  406  FORMAT (//2X, 13H****F-RATIO = F10.4.3X, 12H  D.F. NUM. = F5.0, 12H D.F.
       1 DEN. = F5.0, 3X, 14, F7.4, 14, F7.4)
       GO TO 31
  326  END
```

Appendix (con't) L-9

PRIMSC (LMEAN, LSIGMA, LCORR, NVAR

PRINT MEANS, STANDARD DEVIATIONS, AND CORRELATIONS

REQUIRES PRINT

PRINTS MEANS, STANDARD DEVIATIONS, AND CORRELATIONS, STORED BEGINNING IN CORE LOCATIONS A (LMEAN), A (LSIGMA), A (LCORR), RESPECTIVELY. NVAR IS THE NUMBER OF VARIABLES. THE OUTPUT HAS FOUR DECIMALS AND THE CORRELATION MATRIX IS PARTITIONED BY COLUMNS OF TEN.

```
C       PRIMSC
        PRINTS MEANS, STANDARD DEVIATIONS, CORRELATIONS
        SUBROUTINE PRIMSC (LMEAN, LSIGMA, LCORR, NVAR)
        DIMENSION FMT1 (22), KFMT1 (22), FMT2 (22), KFMT2 (22), A (1), KA (1)
        COMMON FMT1, FMT2, A
        EQUIVALENCE (FMT1, KFMT1), (FMT2, KFMT2), (A, KA)
    20  PRINT 30
    30  FORMAT (41H1  MEANS-STANDARD DEVIATIONS-CORRELATIONS )
    40  PRINT 50
    50  FORMAT (///// 10H    MEANS)
    60  CALL PRINT (LMEAN, 1, NVAR, 1, 0)
    70  PRINT 80
    80  FORMAT (///// 24H    STANDARD DEVIATIONS)
    90  CALL PRINT (LSIGMA, 1, NVAR, 1, 0 )
   100  PRINT 110
   110  FORMAT (17H1       CORRELATIONS)
   120  CALL PRINT (LCORR, NVAR, NVAR, 1, 0)
   121  RETURN
   122  END
```

APPENDIX M-1

Sample Lessons

The lessons were devised to provide a common basis for kinds of activities and sequence of presentation. Some observations from the lessons included:

1. Constant review of and provisions for the exploratory activities were encouraged.
2. In every lesson handling of materials by S took place. Haptic perception was encouraged.
3. All children were encouraged "to do" things.
4. The short attention span was recognized so that the lesson (15 min.) was broken into many varied activities.
5. Throughout the lesson the use of spatial and demonstration of terms, logical reasoning were utilized.
6. Left to right progression was introduced and followed.
7. Many S's were unfamiliar with pencil, crayon, or scissors. Therefore, motor development was at various levels.
8. Children's work was a prominent part of each lesson.
9. Verbal competency was encouraged throughout the experiment.

Appendix (con't) M-2

Sample Lessons: Approximately 30 exercises were outlined by the directors and and enriched by the research assistants. Some lessons consumed two class periods.

Lesson 1: Line - 2 - 3 - 4 - 5

Objective: To teach concept line

Vocabulary: Line, point, curved, straight, slanted, diagonal, round flat up-down, left-right.

Materials: String-yarn - counters - popsicles sticks, crayons, pencil, pipe cleaners. Box with a thin layer of sand, sand-paper strips for tracing.

Procedure: Place two points on chalkboard or paper. Connect with a straight line. Ask S what was made. Have S make dots, connect them. Find lines in environment: edge of paper, desk, window, etc.

Activities:

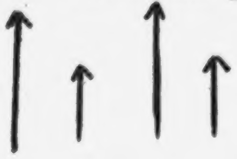
1. With string and poster paint make pictures.
2. Trace lines in sand: straight, wavy, slant, etc.
3. Use pencil - free making of lines - large muscle development.
4. Show cards with lines. Have 2 of each card.

Child identified kind of lines. Matched cards.

5. Child traced lines with fingers. Lines were on large cards.

From cards in #5 child identified lines as: Show us the straight - wavy - long - short, line.

6. Child made lines on paper learning up-down, tall-short, etc.



7. Sandpaper lines traced by child's two fingers from left to right.

Activities (Cont'd)

8. Paper strips about 6" - 5" - 4" - 2" - 2" long 1" wide. Arrange as

6" then 2"
5" 3"
4" 4"
3" 5"
2" 6"

Child arranges length of line in decreasing or increasing order.

Lesson 2: Square

Objectives:

1. To review Lesson 1.

2. To integrate vocabulary used in Lesson 1 and apply in Lesson 2.

3. To teach concept square.

Vocabulary: side, corner, the same as, equal square, across, top, bottom, large, small, side to side.

Materials: pieces of plastic, straws, string, crayon-pencil, clay, sand box forms - wooden and metal forms - colored paper cut into squares.

Procedure: Make 4 dots equidistant as ⁚ ⁚ - (Place dots to make square) - connect lines to make square. In doing so, say to child "Watch what I do. I start here (left-upper dot) and go to this dot (upper right)." Do same with bottom. Then connect dots to complete square. Do a number of times. Each time say, "We are making a square."

Activities: As E represents square S makes square on paper or board. Each time S tells what he has made. Make square popsicle sticks; clay; pieces of plastic strips, etc.
Give child 4 cut out squares differing in size - largest to smallest. Find the largest - the smallest - arrange from largest to smallest and vice versa. Hold a cut-out square before child. He matches square with form on flannel board.
Trace with fingers the outline of the square.

Appendix (con't) M-4

Lesson 3: Circle

Objectives:

1. To review previous lessons.

2. To teach concept circle.

Vocabulary: round circle, fold, half, large, larger, largest.
Review previous vocabulary.

Materials: sand box, cut out circles, pencil-paper, string, clay, plastic - wooden - metal forms-sand paper cut outs of circle, half circle forms.

Procedure: Draw a circle on paper or board and give nam of form. "What is in the sky that looks like a circle?" (point to circle.) Child traces forms with fingers. Child makes a circle. "Now I am making a larger one. Now another one. It is the largest." Point and say "large, larger, largest." Have S make circles - use crayons - pencil. Take half circle and place it on whole circle. "We call this one half." Demonstrate how parts (2) go together. Give S a circle. Teach how to fold and cut. Put pieces together.

Activities: Arrange by size.

Place in S's hand circle and square. He identifies each haptically. Make circles in environment: clock, eyes, buttons, designs, etc. Have child make circle design.

Lesson 4: Triangle

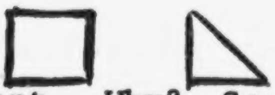
1. To review square, circle, line.

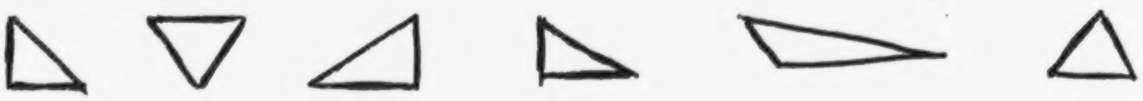
2. To teach concept triangle.

3. To show many different kinds of triangles in various positions.

Vocabulary: Triangle, angle, tri, top, bottom, point.

Materials: Montessori forms for triangles - Flannel board, clay, paper, sand - Triangle of rhythm band.

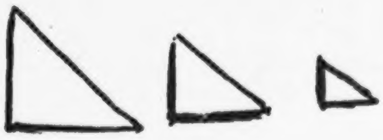
Procedure: Place square and triangle - 
Ask if they are alike-different. Why? Square has 4 corners; triangle has three.



Why are these called triangles? Each has 3 angles or 3 points. Have child point to angles and count, one, two, three.

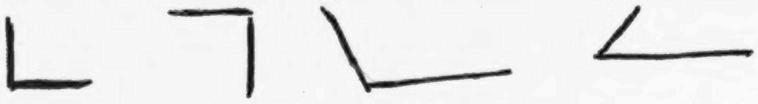
Lesson 4: Triangle (Cont'd)

Activity: Place triangles to be arranged by size -



Make in sand; with clay; with straws, string, etc. Trace sides of a triangle; Saying, "this is a triangle. It has one side (tracing), two sides, three sides."

Find triangle in environment. Give child triangle with side missing. Child completes the triangle.



etc.

Child cuts triangles from colored paper to make design.

Lesson 5: Circle - Half Circle

Objective:

1. To review circle.
2. To teach "half a circle."
3. To teach concept "half."

Vocabulary: Half, not so large as, whole, part of, curved line, straight line.

Materials: Montessori forms - Many circles cut from colored paper - cut in halves. Flannel board, clay, paper, sand.

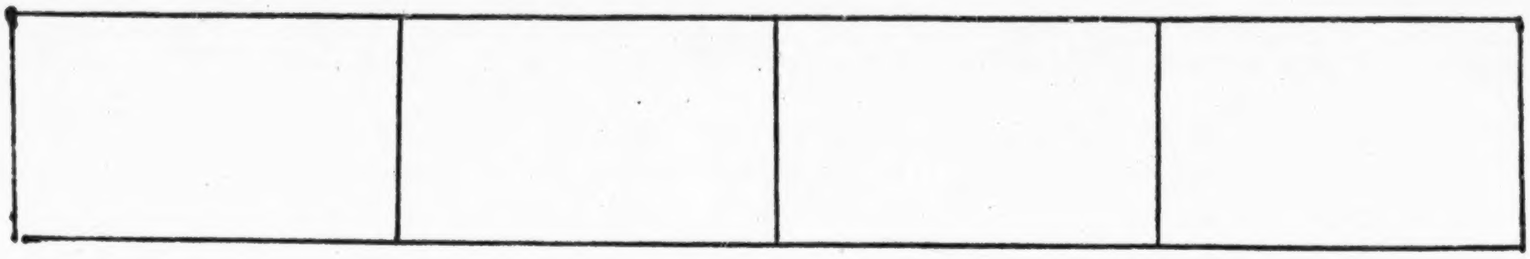
Procedure: Show circle. Using different color but same size, place two forms on original circle. "How much can you see?" "How much is covered?" Have S trace circle with fingers. "It is round." "It is a whole circle." Then trace half circle. "It is a half circle?"

Activities: Arrange whole circle with matching half circle. Take whole circle - fold - cut in halves. Find circles - whole or half forms in environment. Work in sand. Use clay - make various size half circles.

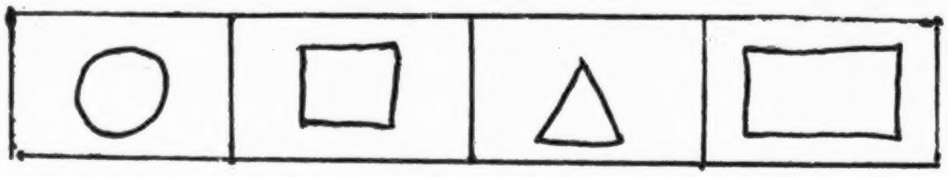
APPENDIX N-1

Suggested Activities:

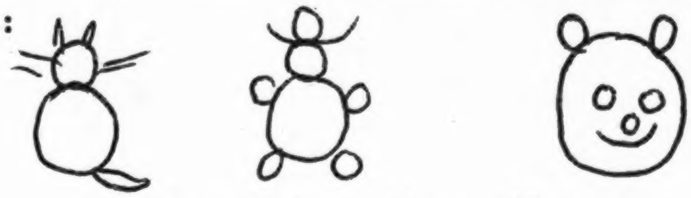
1.

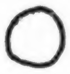
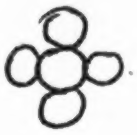
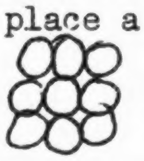


Start a collection of forms. Make the schema as above and add the form being worked on for the lesson. Example:

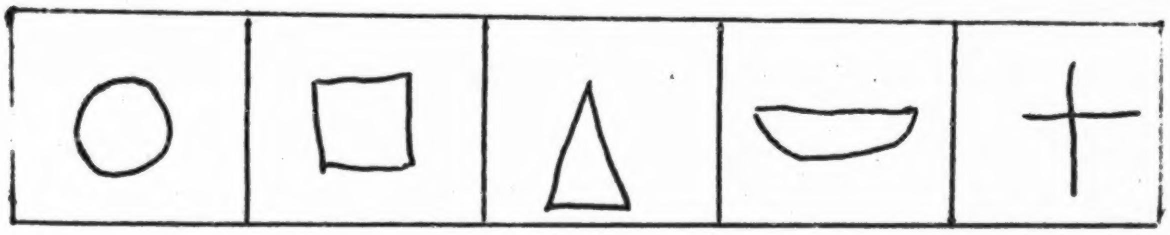


2. Use of circles:



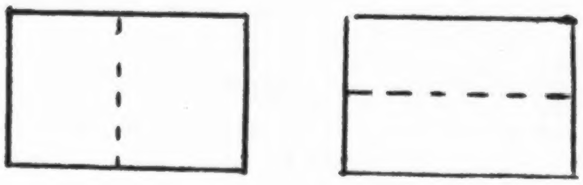
Start with  in center; then add ; then in between each circle make or place a circle. 

3.



Give child card and have him match against above form. Use cards in pre-testing materials.

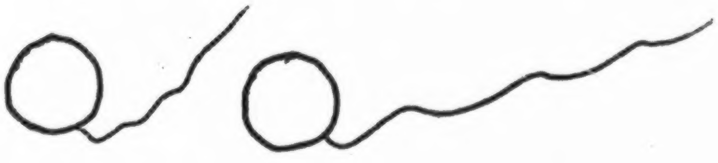
4. Give child 8' by 11' piece of paper. Teach him to fold it in half. "What have we?" (two rectangles). Fold it again. "Now we have ________________________."



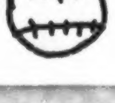
5. Do the same as above with a square 8' by 8'.

6. Circles:

"Let us make balloons."



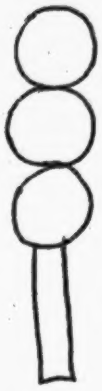
"Let us make a ball."



Appendix (con't) N-2

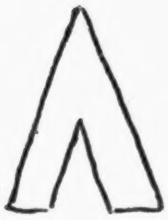
Activities

Traffic Light

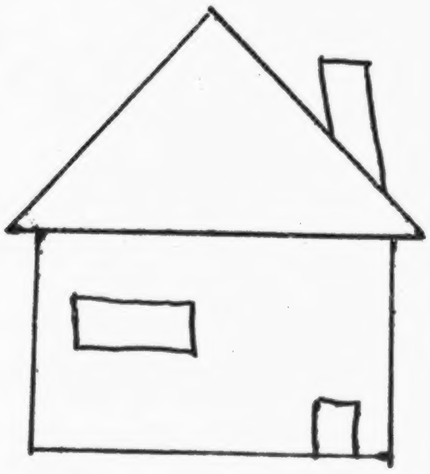


Color green - yellow - red

Tent

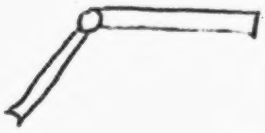


House



Use different colors for geometric form

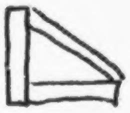
Two pieces on brad



Turn - make lines - angles

Glue popsicle sticks on paper -

Have child identify form. Give small paper right triangles - child places them in order as



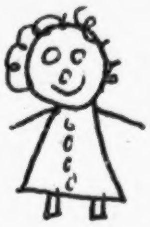
etc.

6. Circles:

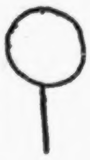
"Let us make balloons."

"Let us make a ball."

"Let us make a girl."

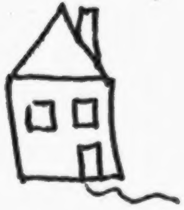


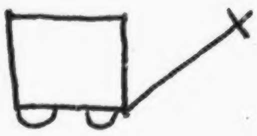
"Let us make a lollipop."



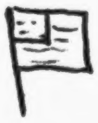
7. Squares:

"Let us make a house ; a truck ;



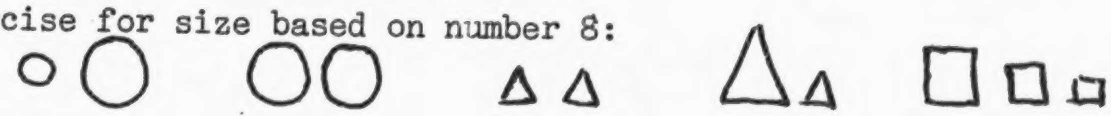


a flag



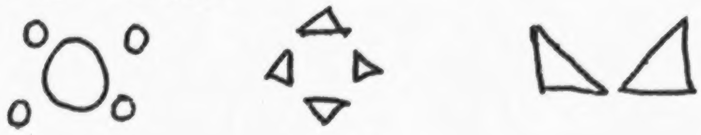
8. Comparative sizes:
  same size
  just alike
  larger than
  smaller than
  same as
  different from

9. Exercise for size based on number 8:

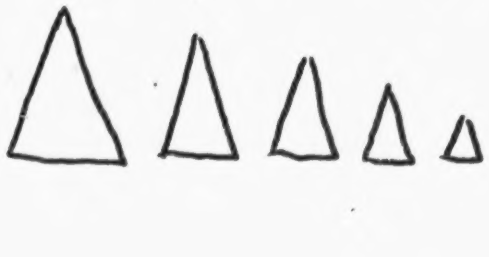


"Show me the smallest." "the largest." "the two that are the same."

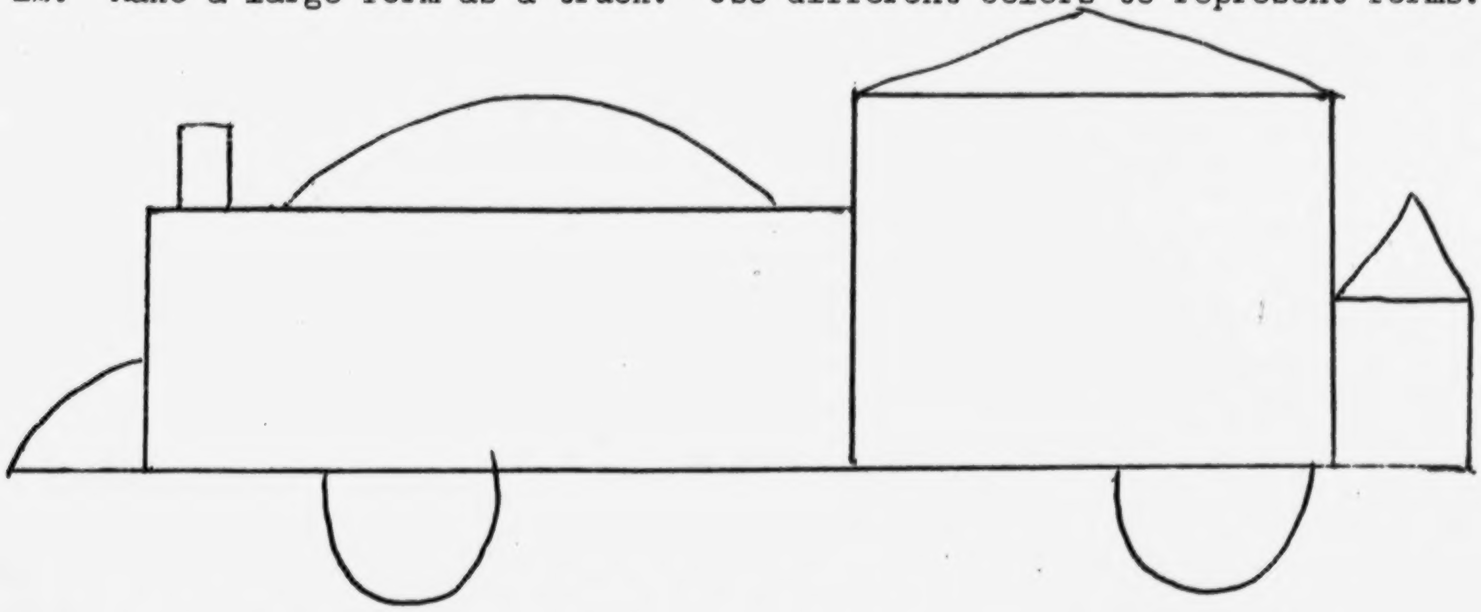
10. Forming designs:



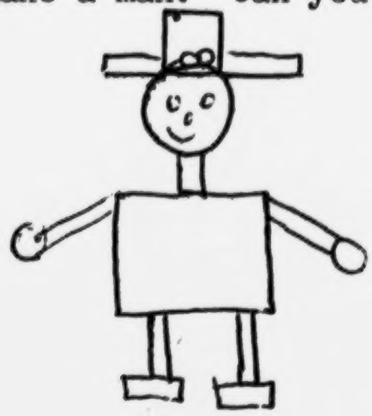
11. Placing haptic cut outs in correct order (Use at least five; place the largest one first.)



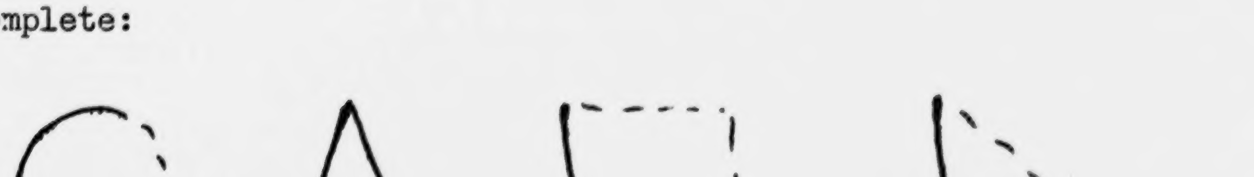
12. Make a large form as a truck. Use different colors to represent forms.



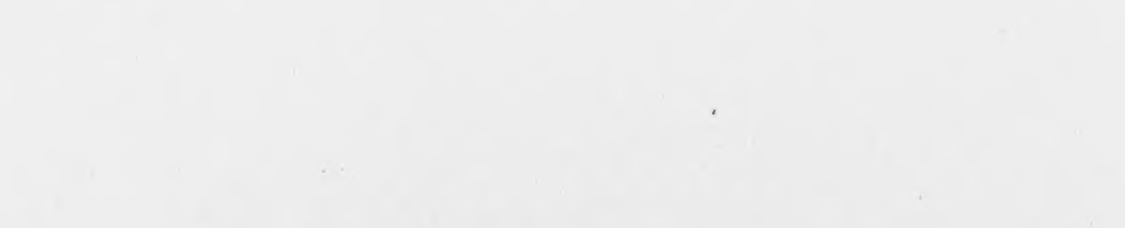
13. "Let us make a man. Can you name the shape?"



14. Make in pairs - a larger and a smaller; use the same color; have the child identify by name.

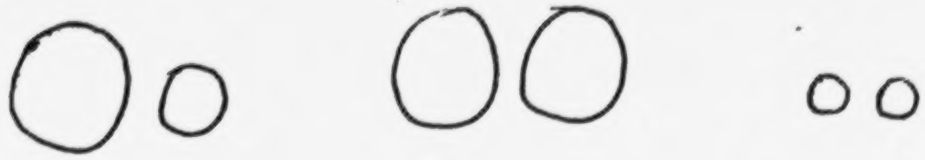


15. Complete:

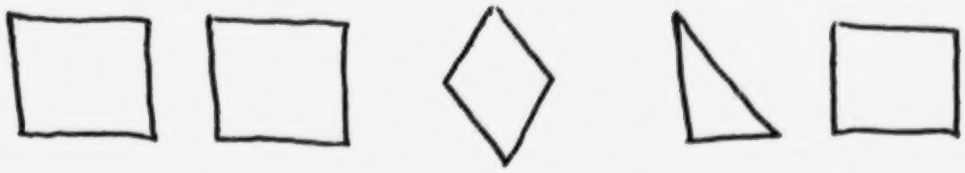


16.

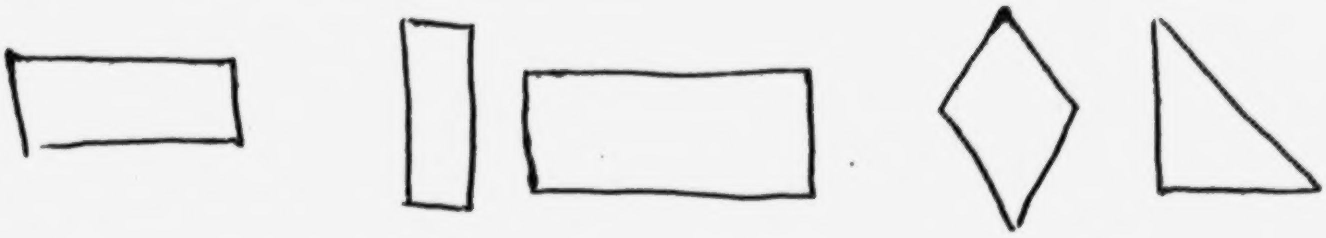
Mark the circles that are the same.



Mark the forms that do not match.

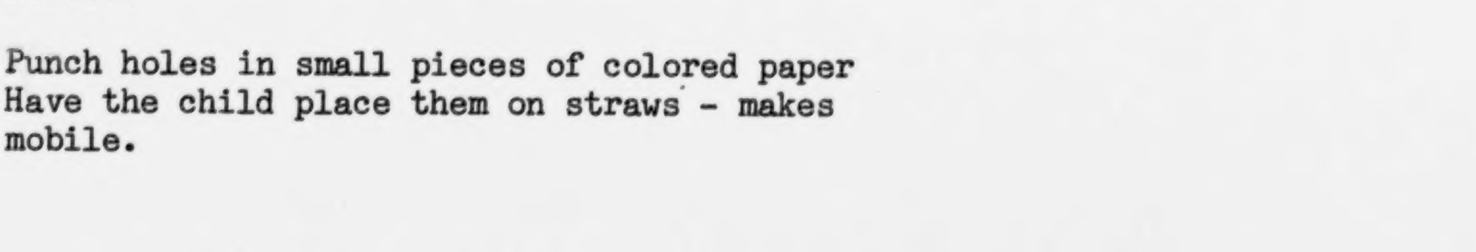


Mark the rectangles.



This page can be done for many of the forms.

17. Repeat design or pattern.

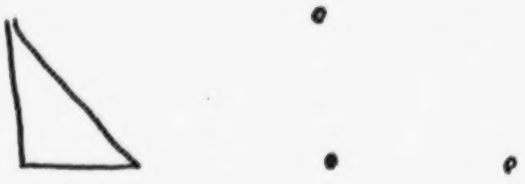


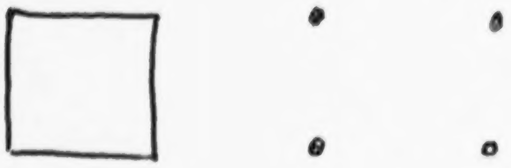
18. Straws:

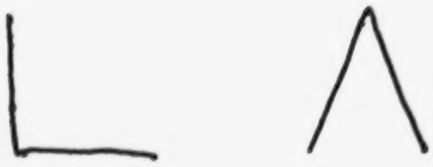
Punch holes in small pieces of colored paper
Have the child place them on straws - makes
mobile.

etc.

Seat Activities

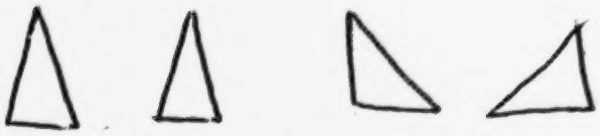






- Complete lines

Card with

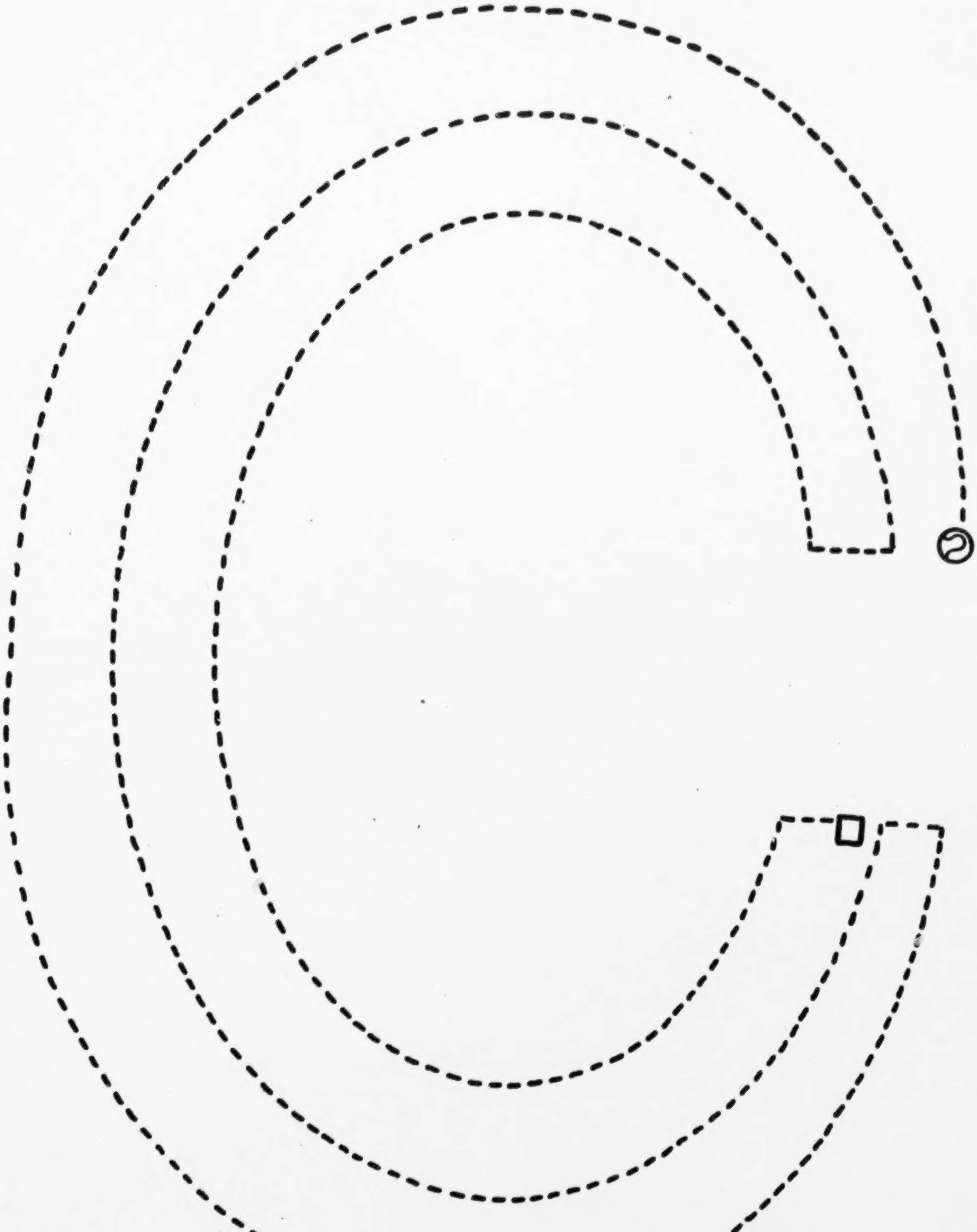


Give triangles and have S match - Each triangle will fit on one above

Make from circles -- various combinations of forms

Train: Using various forms - circle, rectangle, square, **triangle**

APPENDIX O-1



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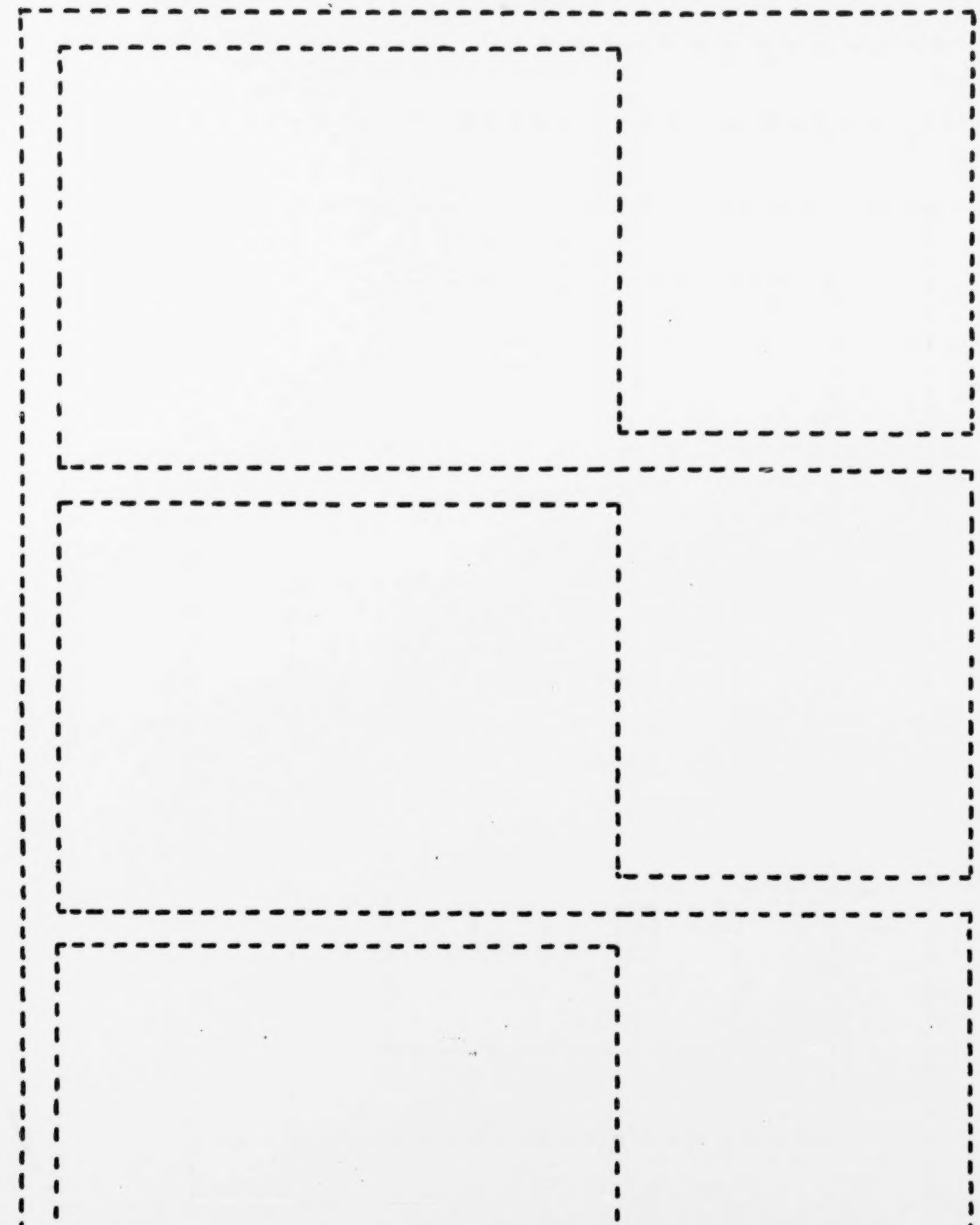

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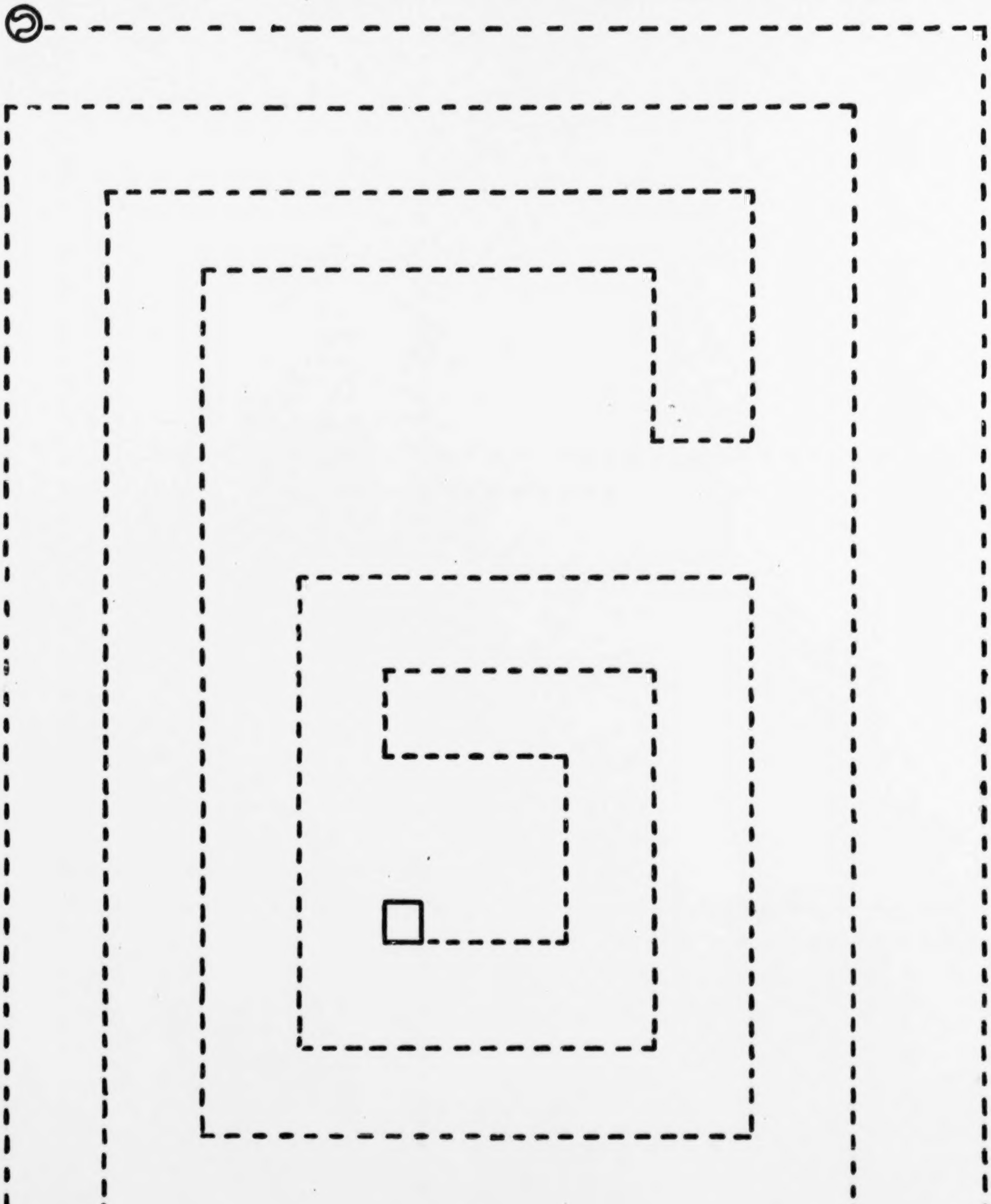

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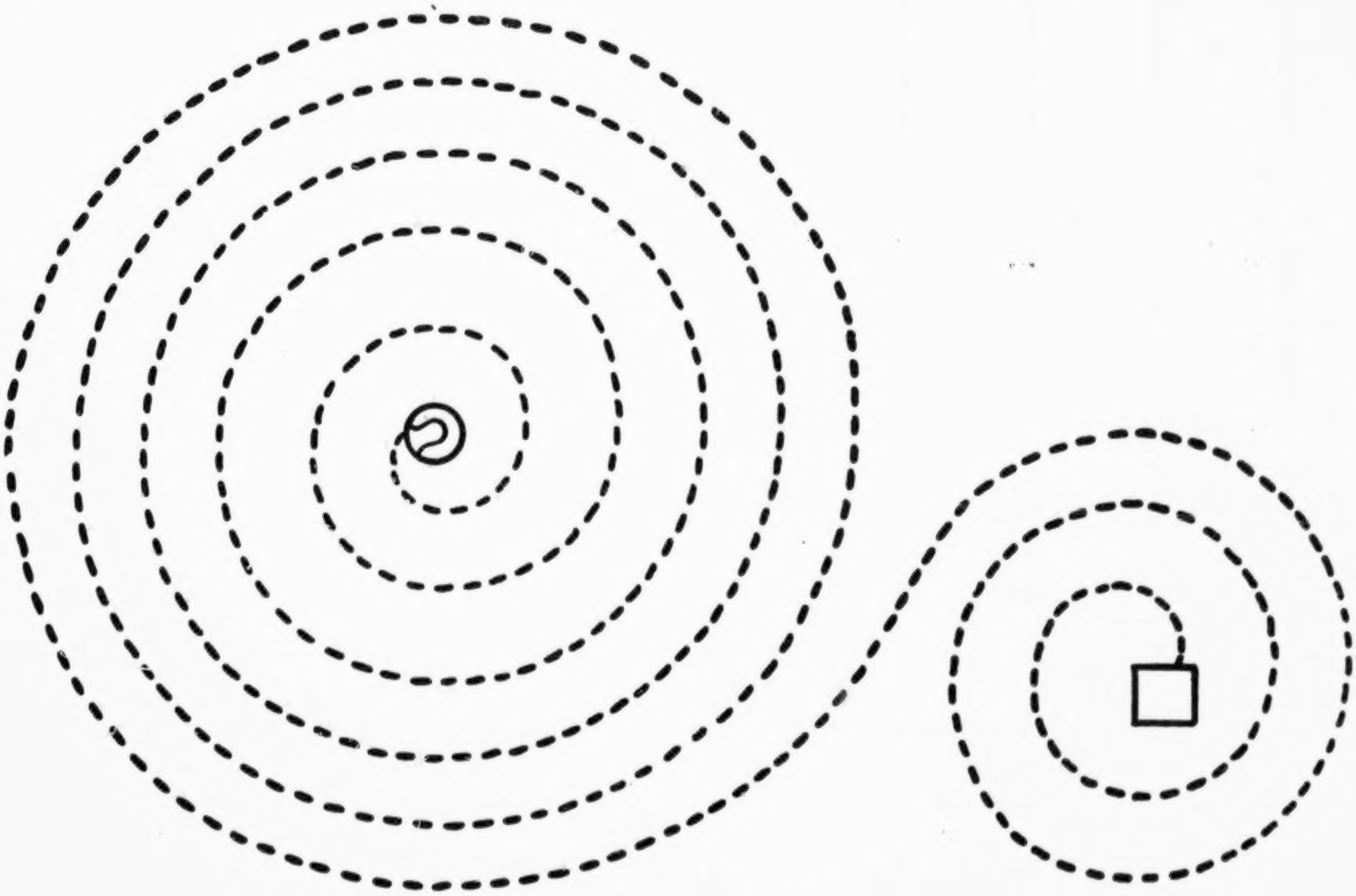

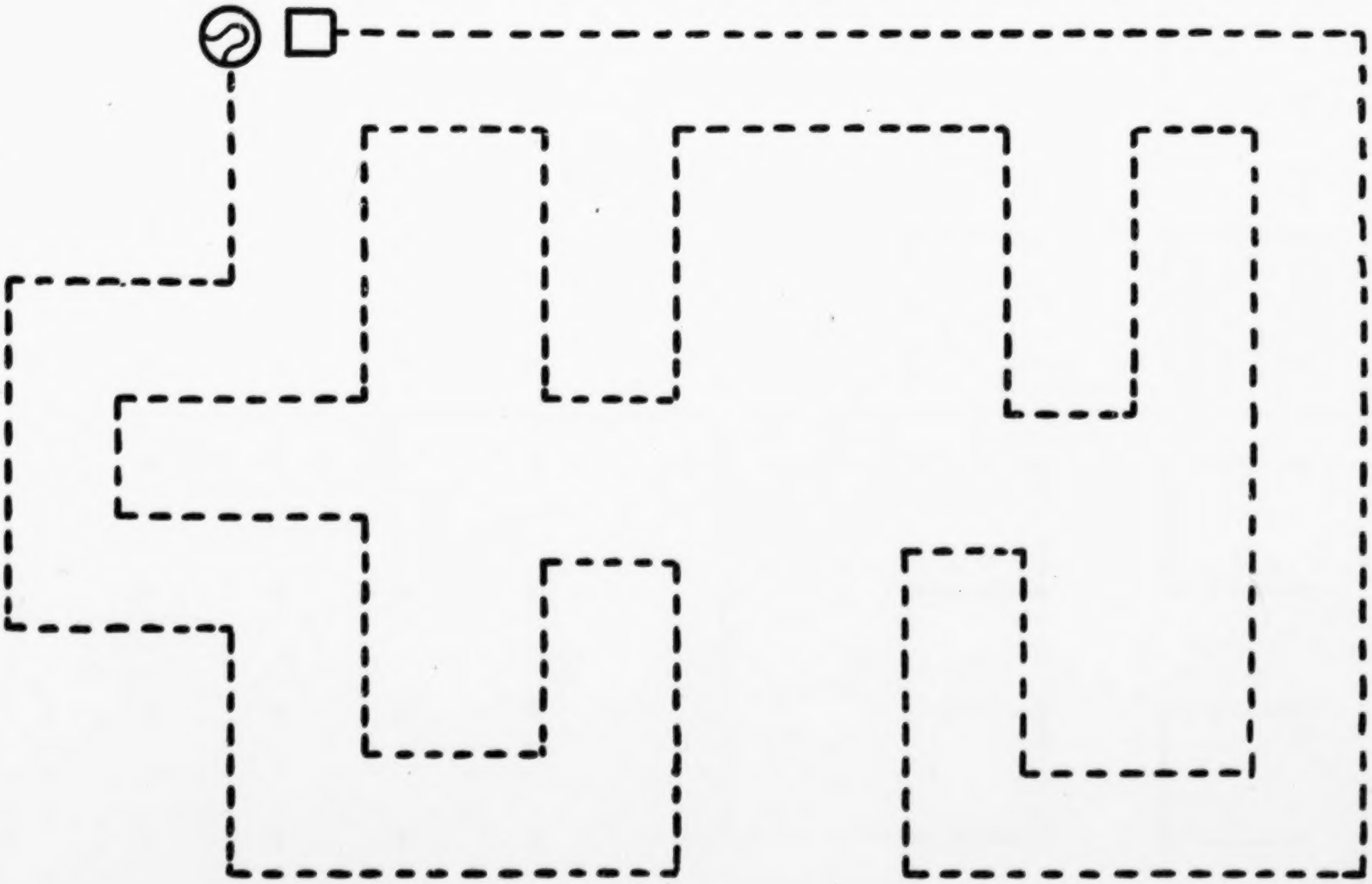

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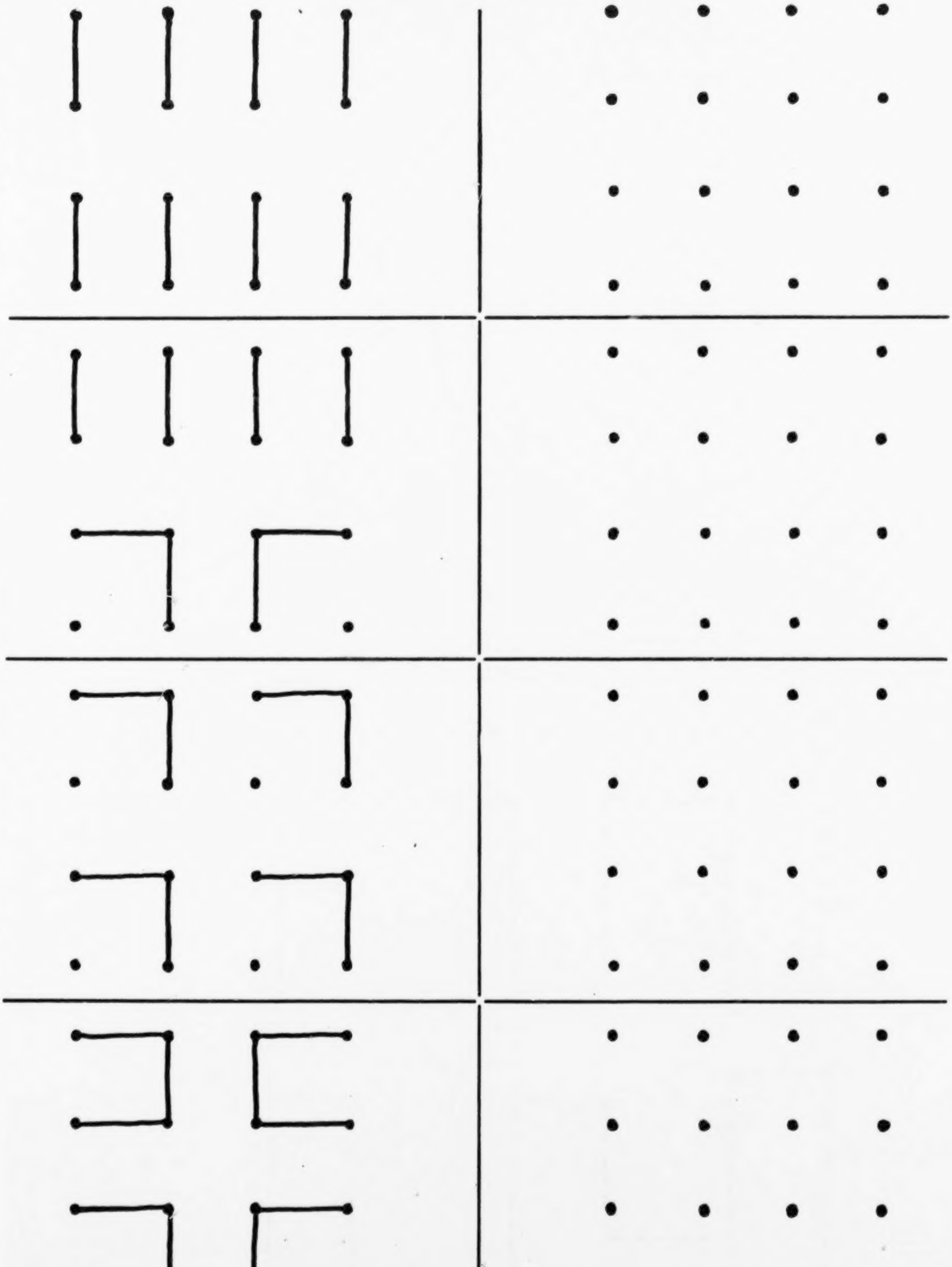

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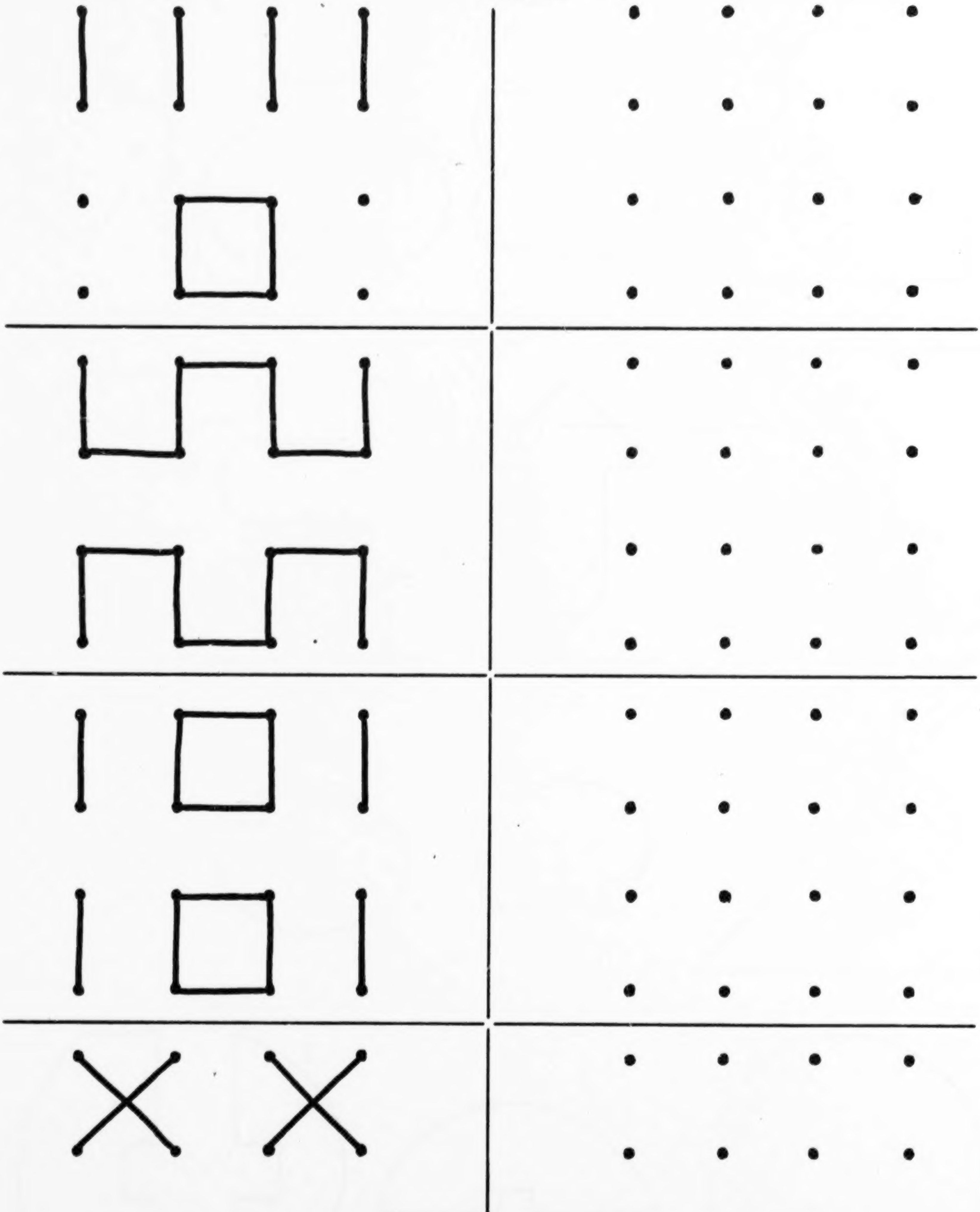

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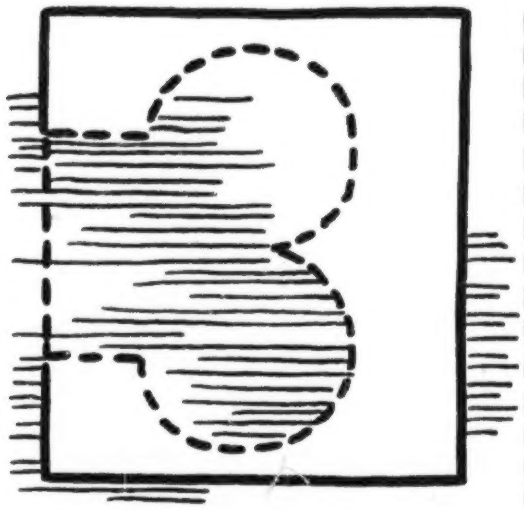

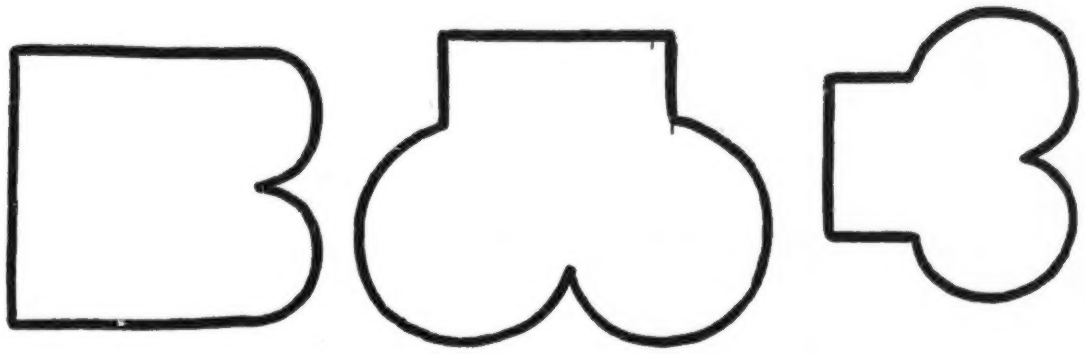

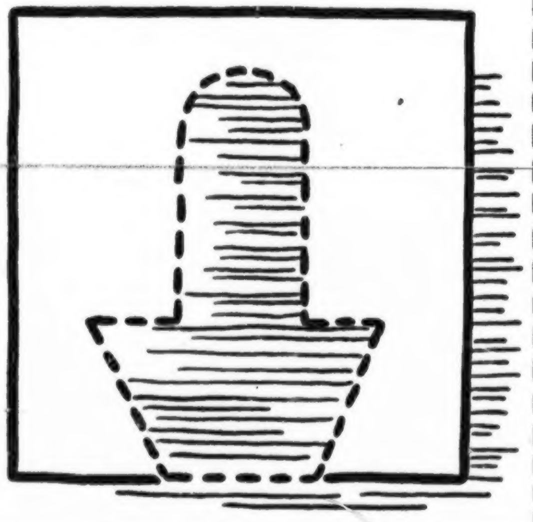

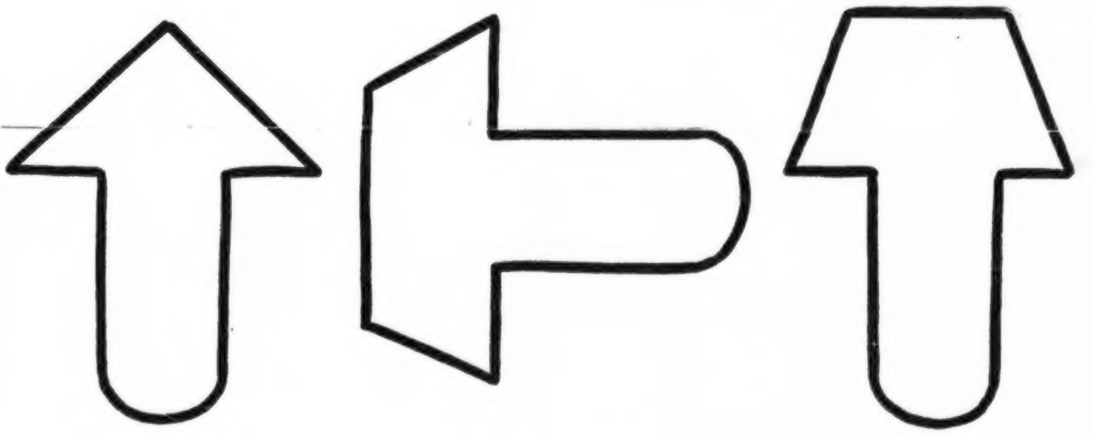

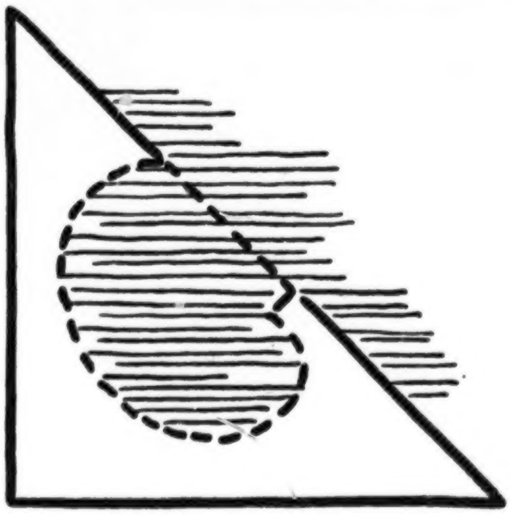

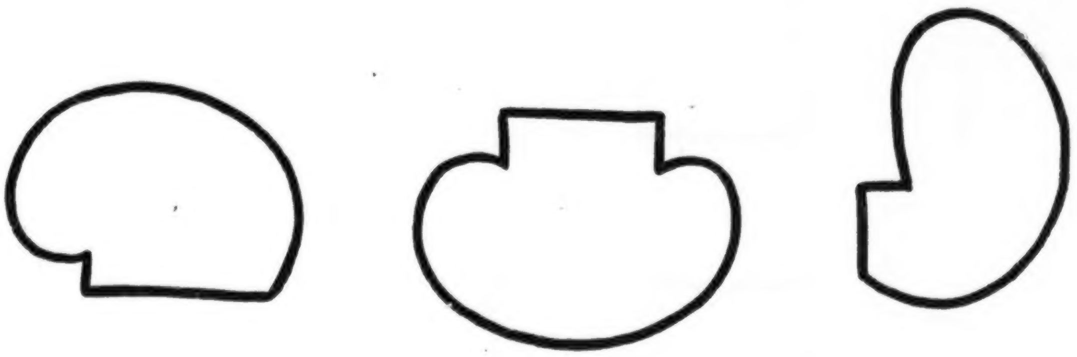

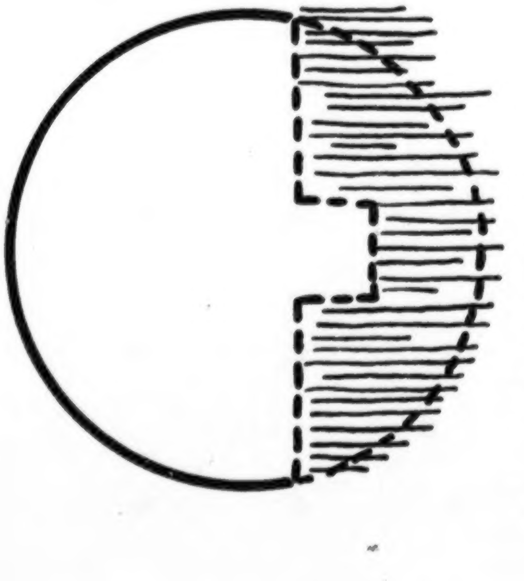

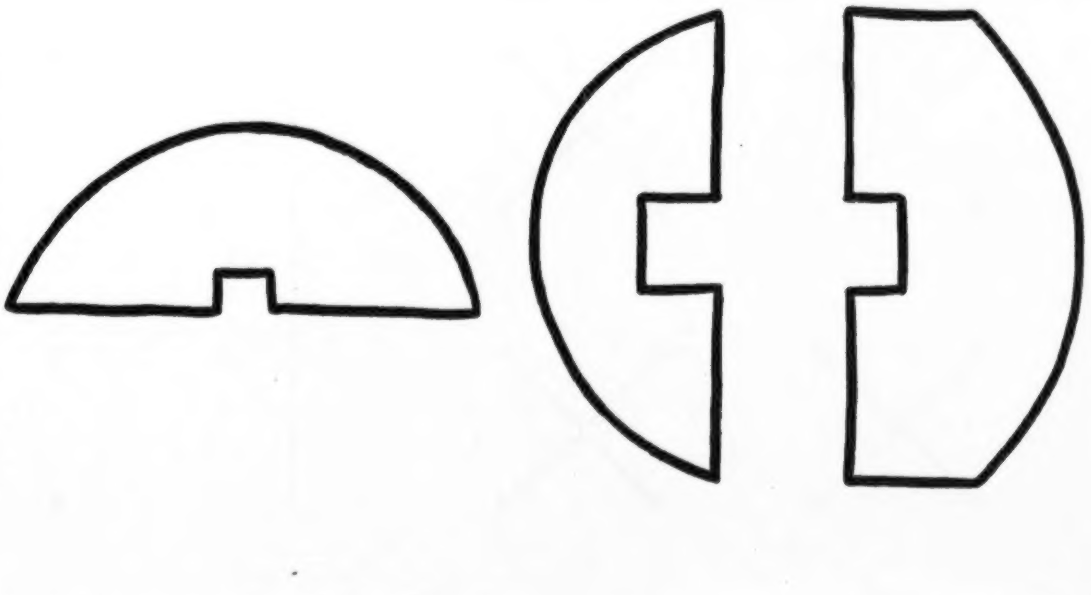

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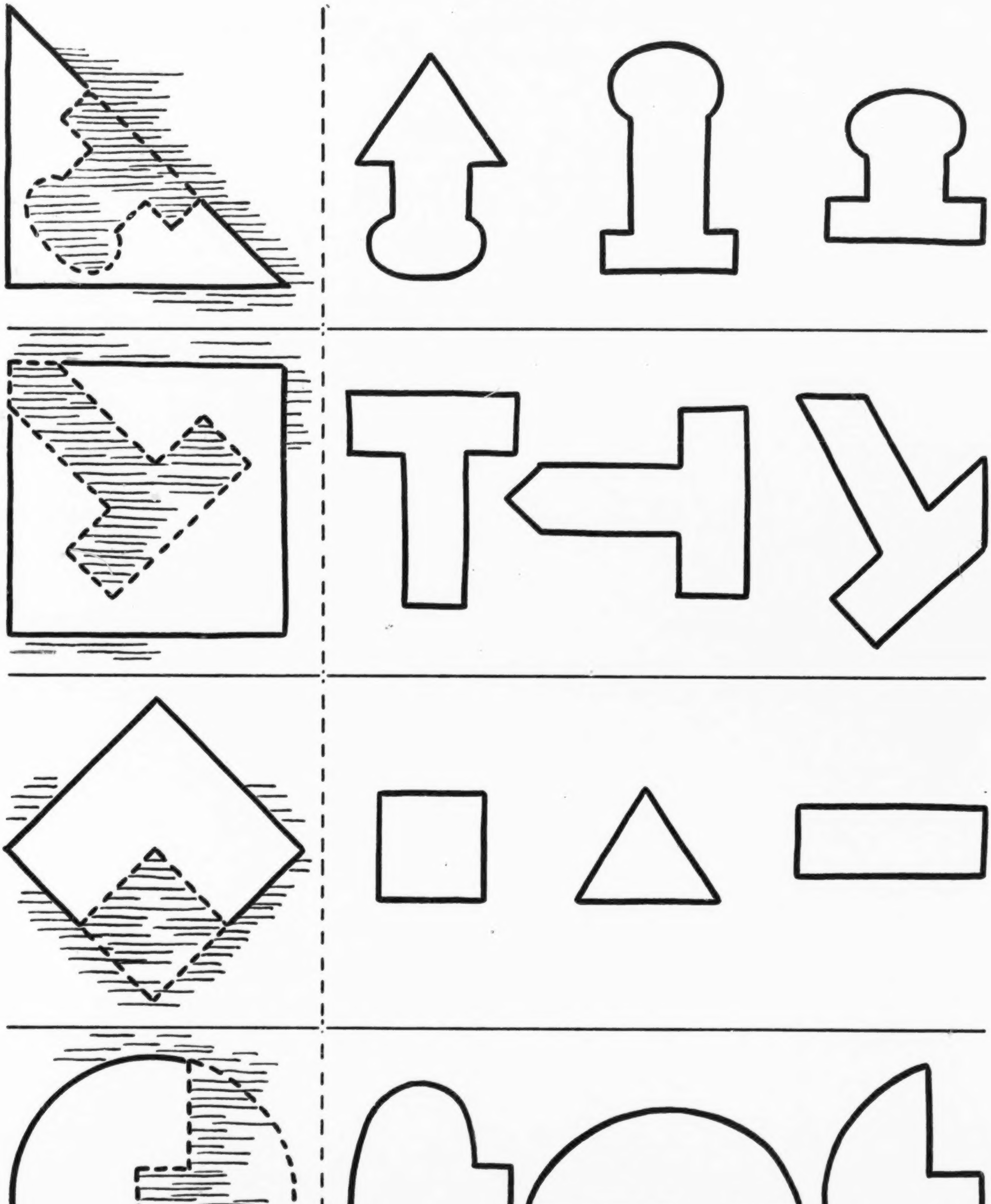

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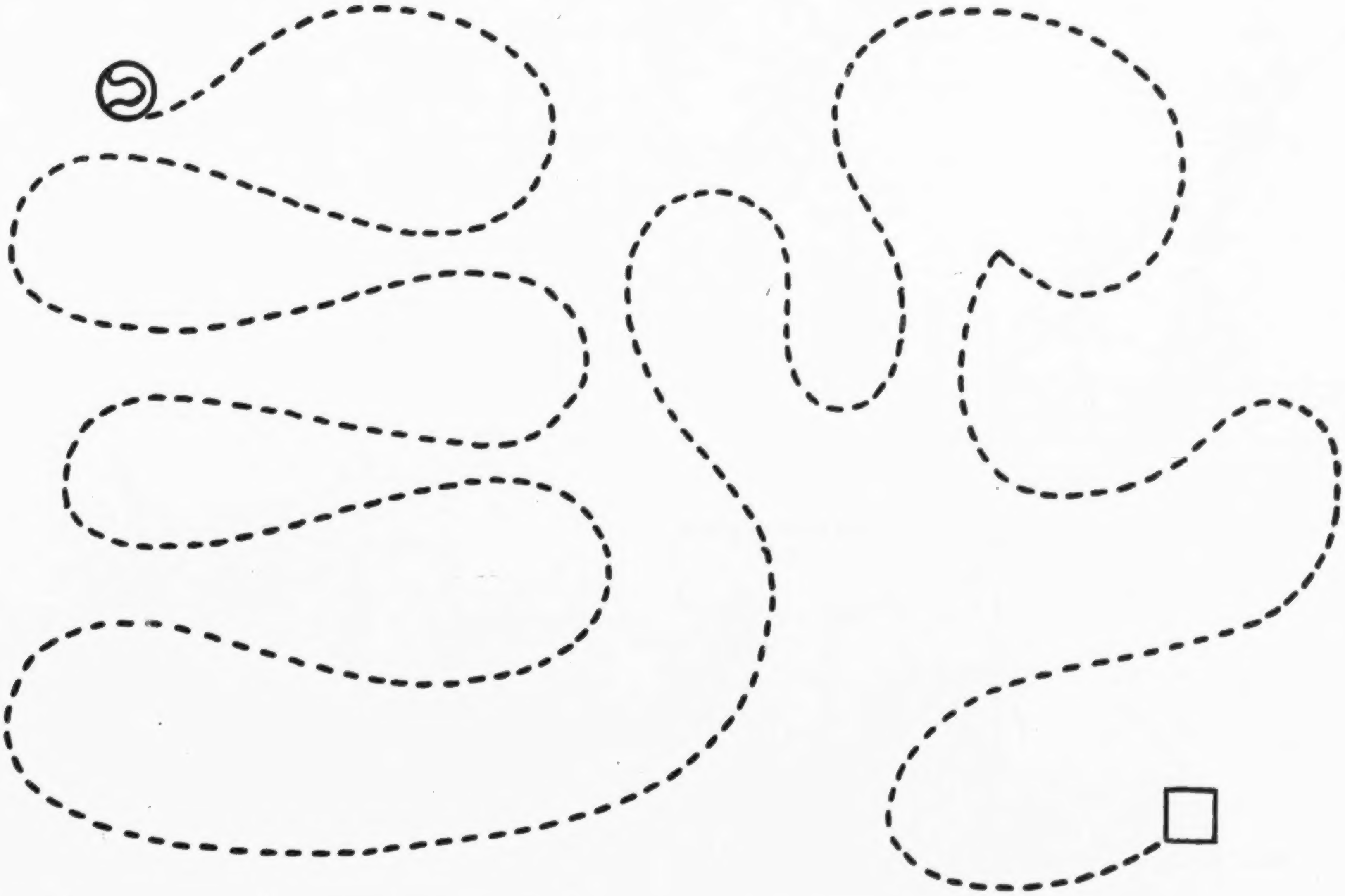

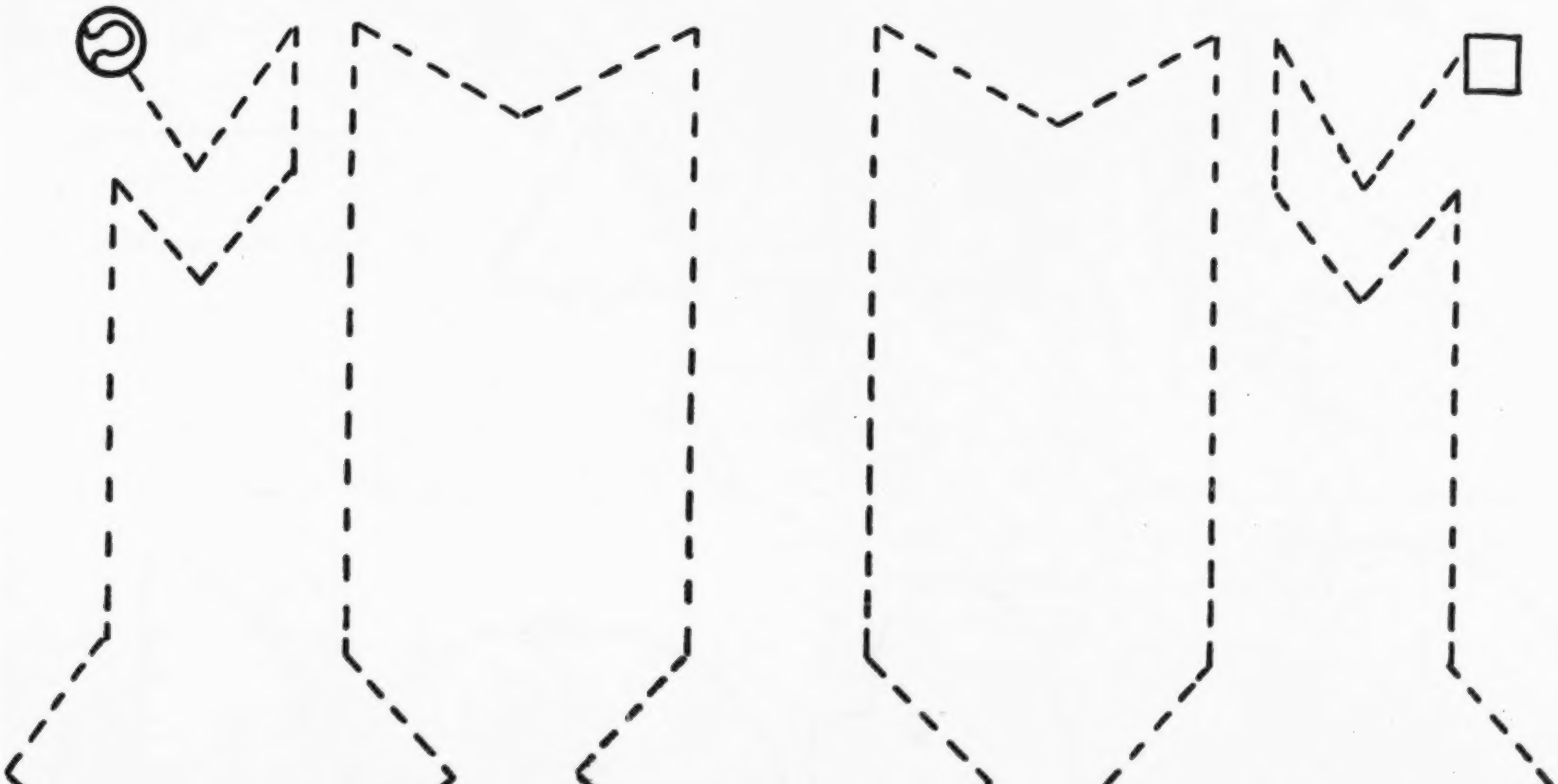

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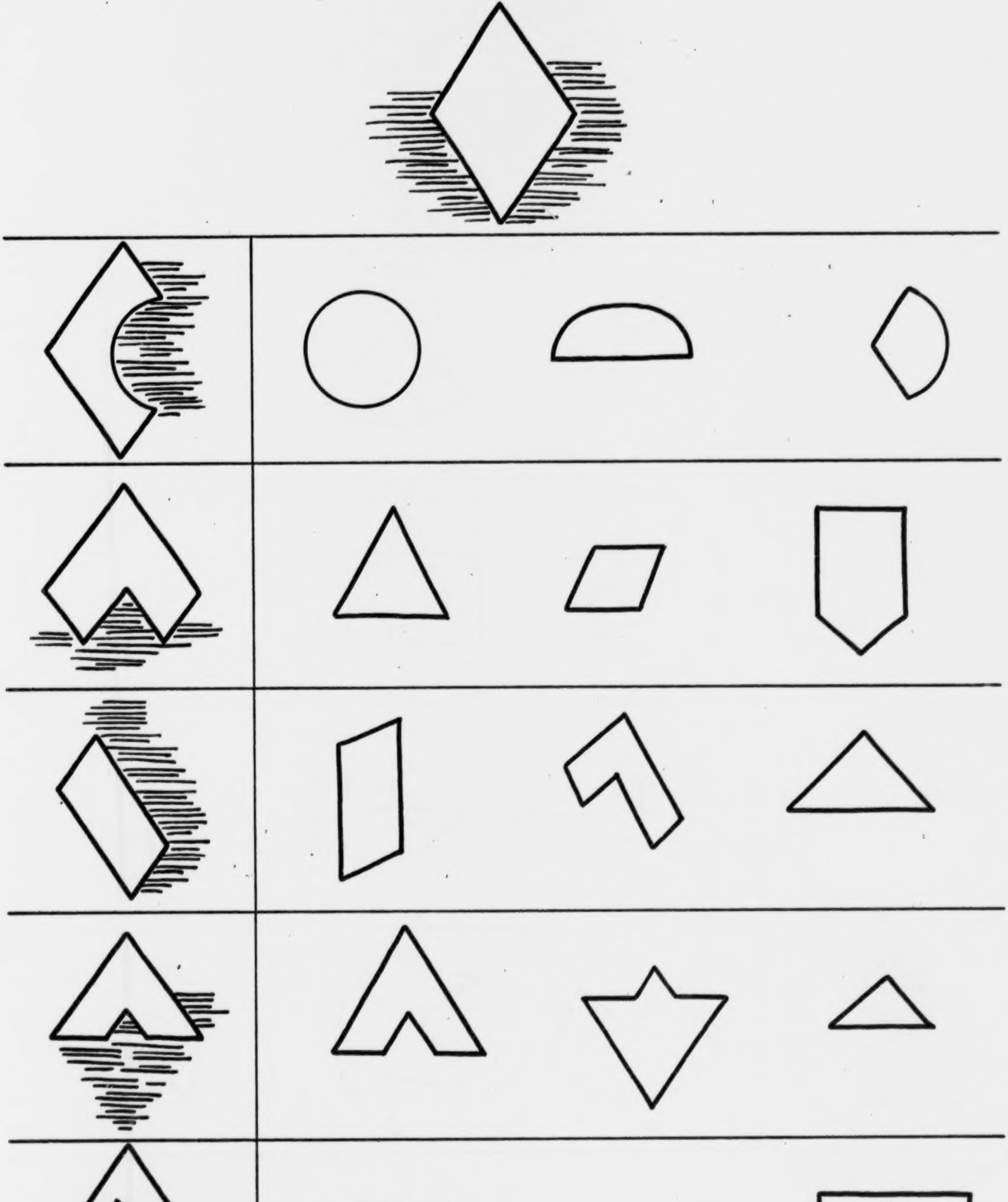
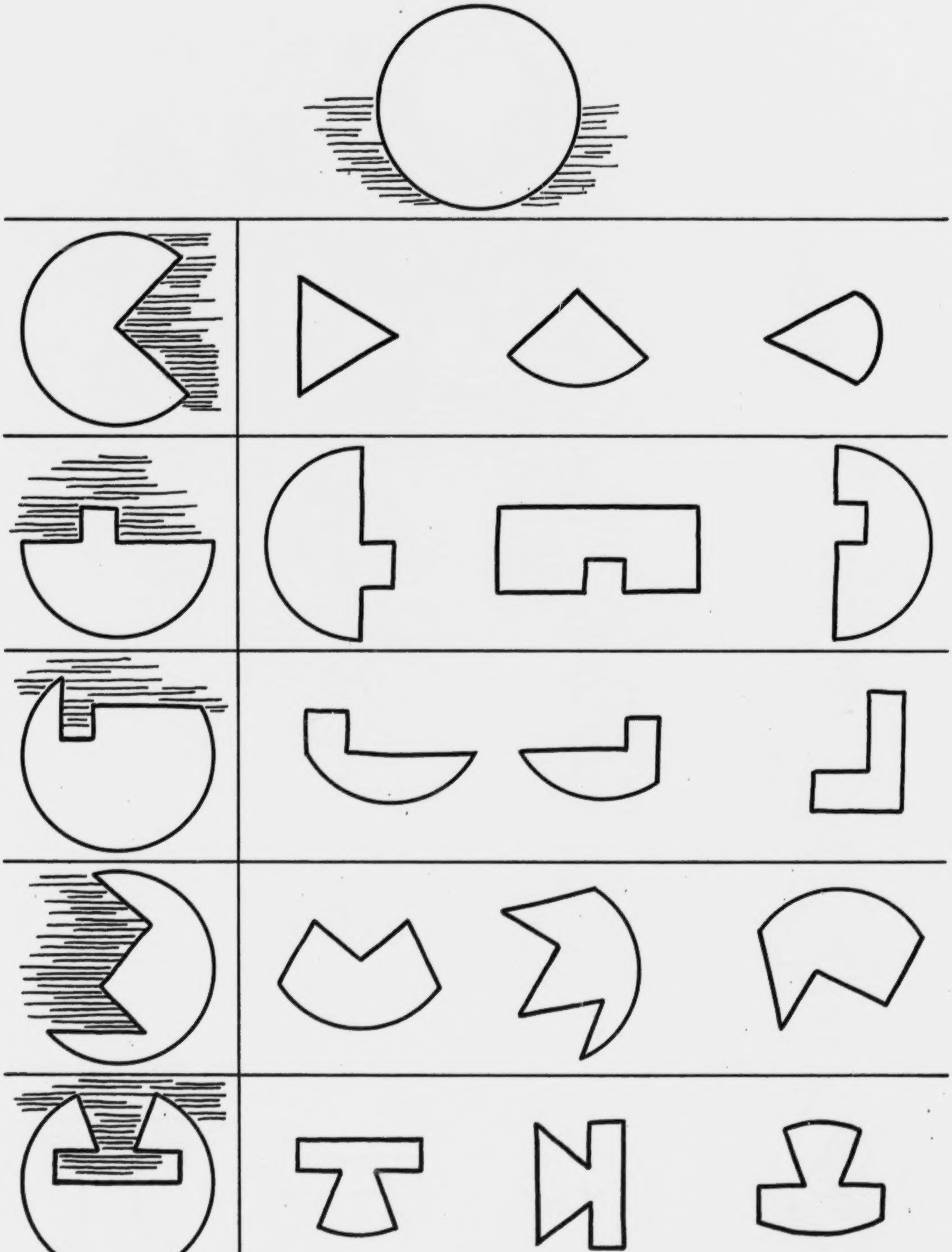
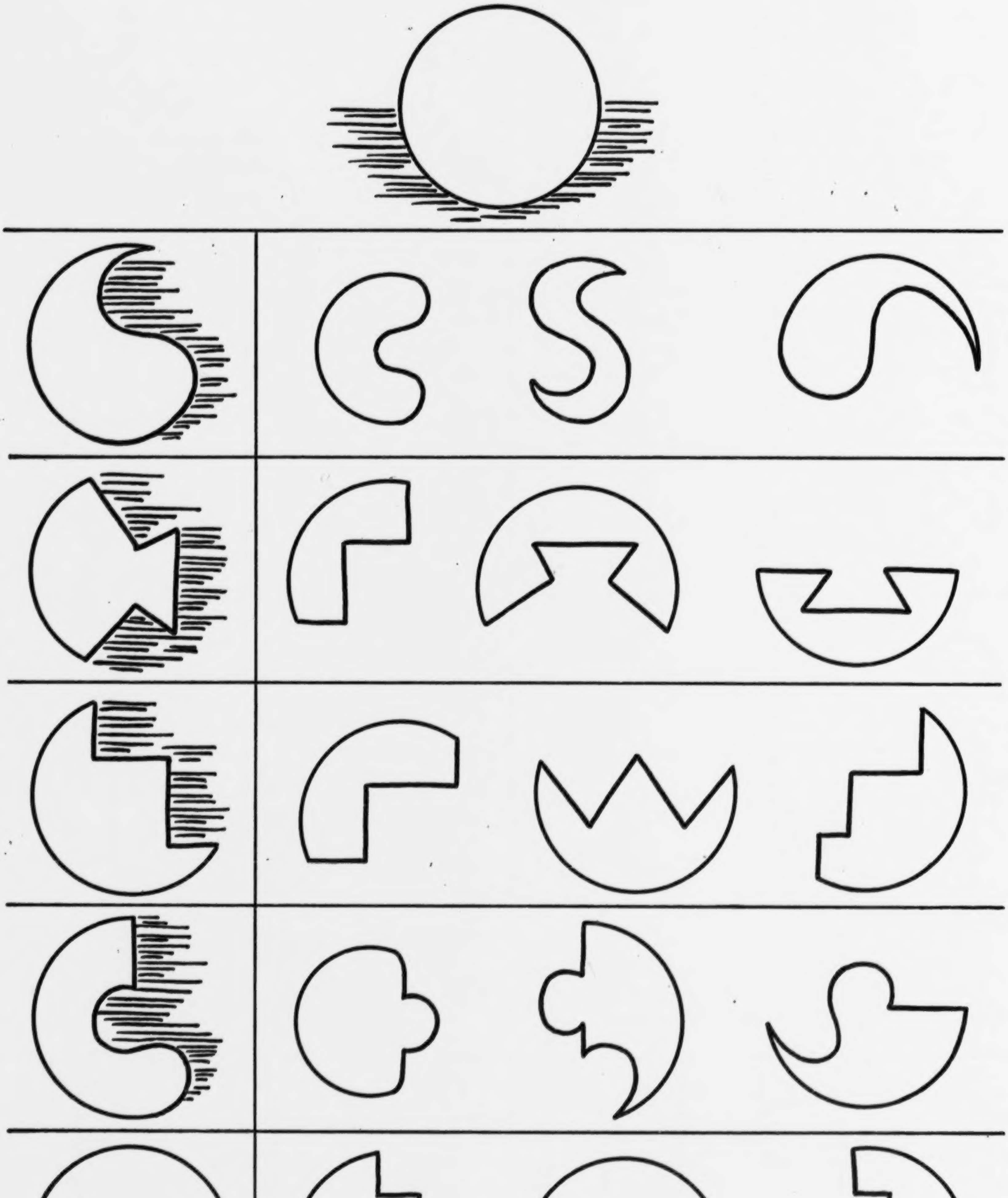


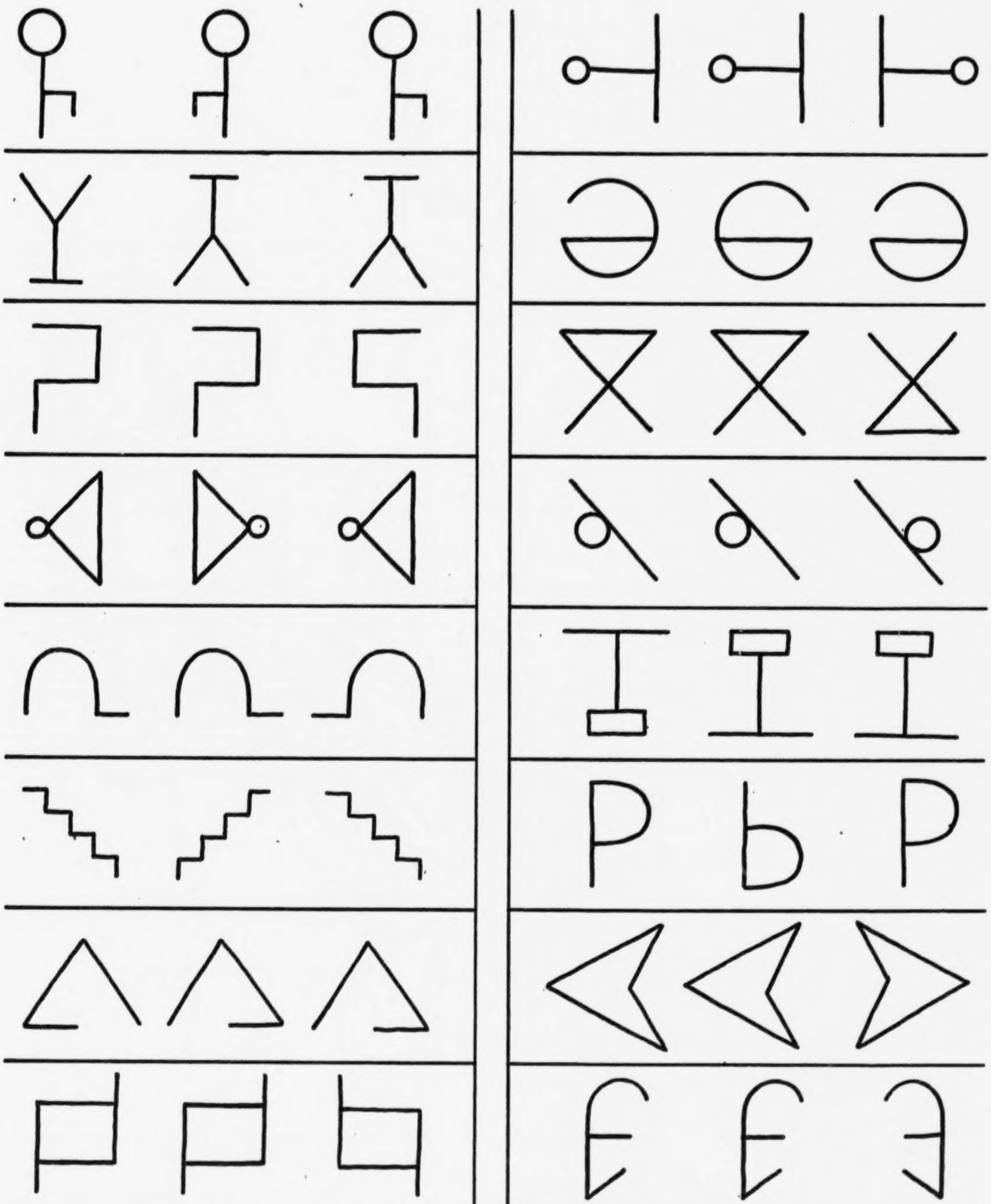
APPENDIX O-11



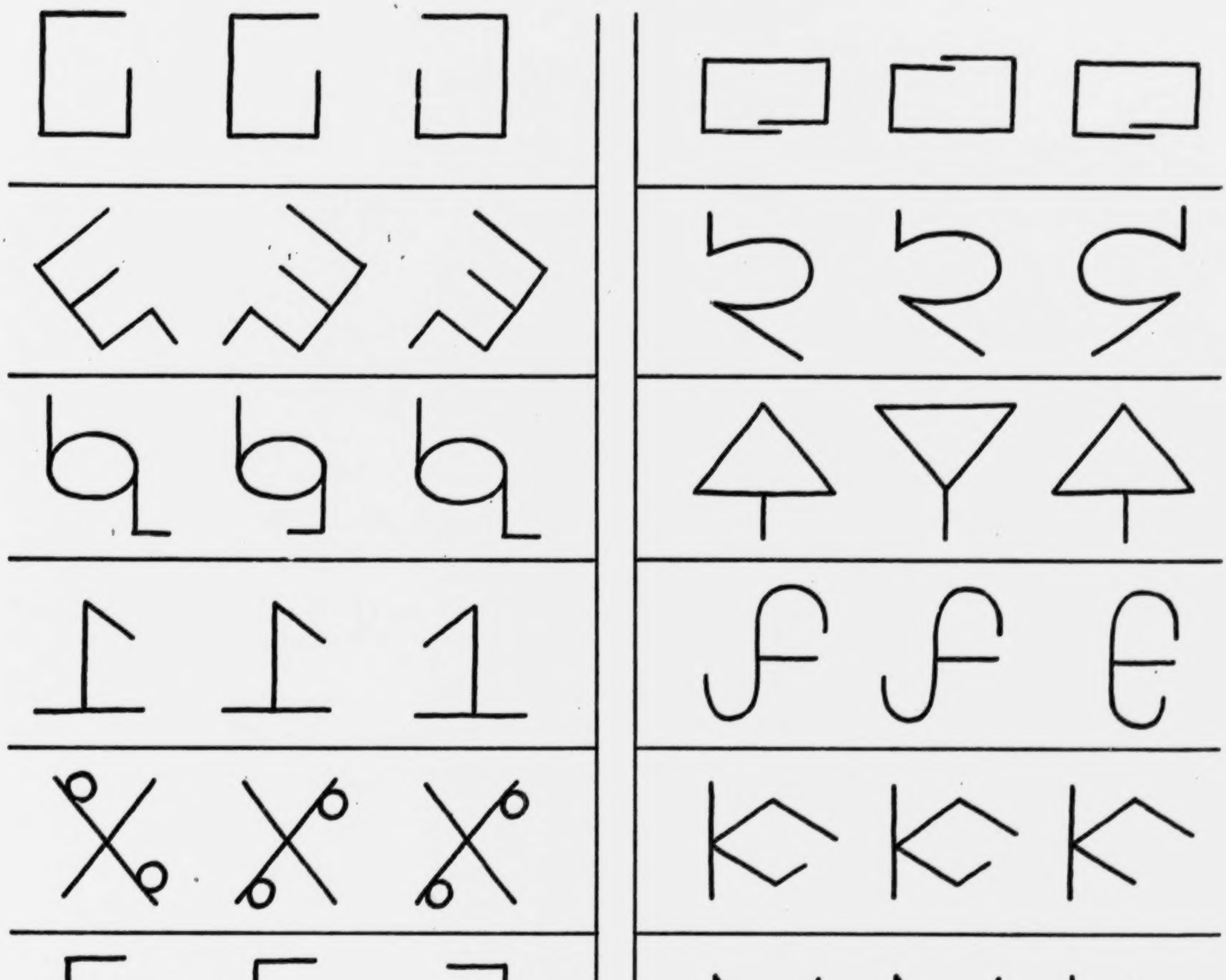
APPENDIX 0-12



APPENDIX O-13



APPENDIX O-14



APPENDIX P-1

MEANS AND STANDARD DEVIATIONS FOR VARIABLES IN HAPTIC TESTS

Variables	No.		Pre-Test					Final Test				
			1	2	3	4	5	1	2	3	4	5
Exp -Ind	48	x̄	4.77	11.31	11.35	3.40	3.65	17.40	17.42	17.85	13.00	17.52
		σ	4.66	5.86	5.85	4.02	4.10	3.81	3.09	2.61	6.19	3.87
Exp -Group	48	x̄	5.33	11.87	12.48	3.19	4.06	17.58	17.10	18.12	13.04	17.12
		σ	5.09	5.66	6.21	3.64	4.17	2.81	2.99	1.78	5.65	3.84
Control	48	x̄	4.21	10.02	11.19	2.75	3.27	9.60	13.37	13.33	5.83	8.75
		σ	4.25	6.12	5.70	4.06	4.09	5.73	5.39	5.50	4.20	5.18
Montessori	74	x̄	2.57	8.85	9.20	1.59	1.68	15.91	16.20	17.31	10.96	15.73
		σ	3.21	6.69	6.28	2.30	2.49	5.23	4.35	4.26	6.46	5.69
Non-Montessori	70	x̄	7.10	13.41	14.29	4.77	5.76	13.76	15.71	15.51	10.27	13.13
		σ	4.90	3.82	4.23	4.59	4.47	5.91	4.41=	4.08	6.29	5.90
A.M.	72	x̄	5.19	11.07	11.81	3.35	4.33	15.04	15.57	16.28	10.54	14.51
		σ	4.98	6.29	6.24	4.38	4.83	5.76	4.67	4.63	6.52	6.20
P.M.	72	x̄	4.35	11.07	11.54	2.87	2.99	14.68	16.35	16.60	10.71	14.42
		σ	4.36	5.56	5.65	3.39	3.15	5.58	4.04	3.88	6.26	5.66
Male	70	x̄	5.14	11.46	12.06	2.39	3.67	14.34	15.43	15.86	10.44	14.23
		σ	4.82	5.64	5.86	3.30	4.05	6.21	5.11	5.26	6.68	6.37
Female	74	x̄	4.42	10.70	11.31	3.80	3.65	15.35	16.47	16.99	10.80	14.69
		σ	4.56	6.18	6.02	4.32	4.21	5.07	3.48	2.96	6.09	5.48
Exp-Ind-Mont	24	x̄	2.42	9.00	8.67	1.62	1.62	18.62	18.12	18.83	13.83	18.96
		σ	3.12	6.77	5.37	2.39	2.45	2.04	1.74	1.46	5.66	1.70
Exp-Ind-Non Mont	24	x̄	7.12	13.62	14.04	5.17	5.67	16.17	16.71	16.87	12.17	6.08
		σ	4.75	3.50	5.01	4.51	4.41	4.67	3.88	3.10	6.58	4.80
Exp-Gr-Mont	25	x̄	3.28	10.56	10.12	1.84	2.20	18.88	17.44	18.84	14.08	19.44
		σ	3.93	6.92	7.36	2.41	3.07	1.88	2.21	1.12	5.51	1.24
Exp-Gr-Non Mont	23v	x̄	7.57	13.30	15.04	4.65	6.09	16.17	16.74	17.35	11.91	14.61
		σ	5.27	3.32	3.03	4.16	4.26	2.96	3.63	2.01	5.59	4.12
Control-Mont	25	x̄	2.00	7.00	8.80	1.32	1.20	10.32	13.12	14.32	5.08	8.92
		σ	2.21	5.84	5.80	2.03	1.65	5.14	5.80	6.08	3.20	4.61
Control-Non Mont	23	x̄	6.61	13.30	13.78	4.30	5.52	8.83	13.65	12.26	6.65	8.57
		σ	4.61	4.52	4.27	5.03	4.72	6.22	4.89	4.56	4.95	5.73
Exp-Ind-A.M.	24	x̄	4.87	10.83	10.62	3.29	3.92	17.42	16.75	17.08	12.04	17.21
		σ	4.69	6.20	6.07	3.99	4.60	3.58	3.02	3.04	6.27	3.87

Gain Score					MA	CA	Yrs. in School	Jack	Keister	
1	2	3	4	5					1	2
12.62	6.10	6.50	9.60	13.87	65.7	54.3	0.79	7.04	333.0	435.8
5.21	6.10	5.92	5.16	5.21	11.57	8.60	0.87	4.00	178.0	136.8
12.25	5.23	5.65	9.85	13.06	66.8	56.5	0.87	6.31	311.8	448.9
5.38	6.03	6.23	4.91	5.67	13.48	8.86	0.78	3.08	180.5	125.9
5.40	3.35	2.15	3.08	5.48	62.2	56.0	0.79	6.25	386.7	435.7
5.36	6.18	5.78	3.00	4.08	12.86	8.07	0.89	3.12	147.5	110.8
13.34	7.35	8.11	9.36	14.05	63.5	54.4	0.19	7.92	345.9	397.9
5.19	6.92	6.13	5.84	5.55	12.53	8.30	0.42	2.99	157.9	122.2
6.66	2.30	1.23	5.56	7.37	66.4	56.8	1.49	5.07	341.6	484.8
5.43	3.95	4.09	4.20	5.10	12.94	8.68	0.65	3.29	186.6	111.9
9.85	4.50	4.47	7.19	10.18	66.3	55.5	0.82	6.89	341.9	452.7
6.11	6.16	6.10	5.24	6.67	14.91	9.19	0.82	3.57	175.8	126.1
10.33	5.29	5.06	7.83	11.43	63.5	55.7	0.82	6.18	345.8	427.5
6.42	6.24	6.42	5.64	5.82	10.10	7.89	0.87	3.28	169.1	122.8
9.20	3.97	3.80	8.06	10.56	65.4	55.4	0.74	6.27	321.5	431.7
6.50	5.63	5.70	5.77	6.52	12.61	7.97	0.84	3.40	185.6	130.4
10.93	5.77	5.68	7.00	11.04	64.4	55.8	0.89	6.78	365.0	448.1
5.93	6.60	6.63	5.09	6.07	12.99	9.10	0.85	3.47	156.3	119.3
16.21	9.12	10.17	12.21	17.33	64.5	52.2	0.04	9.37	342.3	392.7
2.31	6.90	5.22	4.91	2.44	11.68	8.22	0.20	2.67	148.9	124.4
9.04	3.08	2.83	7.00	10.42	66.9	56.4	1.54	4.71	323.7	479.0
4.56	2.93	3.99	3.95	4.95	11.33	8.47	0.58	3.75	203.8	135.0
15.60	6.88	8.72	12.24	17.24	66.0	55.5	0.40	7.24	307.6	386.8
3.72	6.87	7.09	4.96	2.92	12.49	8.44	0.57	2.70	166.2	116.7
8.61	3.43	2.30	7.26	8.52	67.6	57.6	1.39	5.30	316.4	516.3
4.45	4.27	2.22	3.27	4.27	14.44	9.17	0.64	3.15	198.4	97.8
8.32	6.12	5.52	3.76	7.72	59.9	55.6	0.12	7.20	387.8	413.8
4.50	6.63	4.89	2.44	4.04	12.55	7.81	0.32	3.06	151.6	123.7
2.22	0.35	-1.52	2.35	3.04	64.7	56.5	1.52	5.22	385.6	459.4
4.32	3.82	4.23	3.36	2.35	12.73	8.31	0.71	2.84	142.8	88.8
12.54	5.92	6.46	8.75	13.29	65.7	53.1	0.75	7.42	333.9	442.5
5.38	6.83	6.12	4.74	5.78	11.59	8.83	0.83	4.21	178.9	139.7

APPENDIX P-2

MEANS AND STANDARD DEVIATIONS FOR VARIABLES IN HAPTIC TESTS

Variables	No.		Pre-Test					Final Test				
			1	2	3	4	5	1	2	3	4	5
Exp -Ind P.M.	24	x̄	4.67	11.79	12.08	3.50	3.37	17.37	18.08	18.62	13.96	17.83
		σ	4.62	5.47	5.53	4.04	3.51	4.02	3.01	1.80	5.96	3.85
Exp-Gr-A.M.	24	x̄	6.21	13.00	14.29	4.25	5.33	18.42	17.62	18.71	14.17	17.96
		σ	5.35	4.35	5.26	4.46	4.92	2.02	2.00	1.24	5.42	2.89
Exp-Gr-P.M.	24	x̄	4.46	10.75	10.67	2.12	2.79	16.75	16.58	17.54	11.92	16.29
		σ	4.65	6.53	6.56	2.11	2.71	3.20	3.66	2.02	5.66	4.44
Control-A.M.	24	x̄	4.50	9.37	10.50	2.50	3.75	9.29	12.33	13.04	5.42	8.37
		σ	4.71	7.40	6.54	4.49	4.81	5.70	6.02	6.04	4.12	5.92
Control-P.M.	24	x̄	3.92	10.67	11.87	3.00	2.79	9.92	14.42	13.62	6.25	9.12
		σ	3.71	4.40	4.60	3.57	3.15	5.74	4.43	4.89	4.25	4.28
Exp-Ind-Male	23	x̄	5.00	13.22	11.74	2.78	4.13	17.22	17.26	17.91	12.57	17.52
		σ	4.93	4.39	5.64	3.31	4.29	3.89	2.85	2.87	6.54	3.91
Exp-Ind-Female	25	x̄	4.56	9.56	11.00	3.96	3.20	17.56	17.56	17.80	13.40	17.52
		σ	4.38	6.47	6.01	4.50	3.87	3.72	3.29	2.35	5.83	3.84
Exp-Gr-Male	22	x̄	6.27	13.00	15.00	2.59	3.86	18.09	17.55	18.41	14.36	17.73
		σ	4.87	4.20	4.00	2.96	3.49	2.79	2.06	1.47	4.75	3.68
Exp-Gr-Female	26	x̄	4.54	10.92	10.35	3.69	4.23	17.15	16.73	17.88	11.92	16.62
		σ	5.14	6.50	6.92	4.06	4.66	2.74	3.56	1.97	6.09	3.89
Cont-Male	25	x̄	4.28	8.48	9.76	1.84	3.08	8.40	11.88	11.72	5.04	8.12
		σ	4.47	6.48	6.30	3.49	4.20	5.66	6.51	6.42	4.36	5.44
Cont-Female	23	x̄	4.13	11.70	12.74	3.74	3.48	10.91	15.00	15.09	6.70	9.43
		σ	3.99	5.21	4.47	4.40	3.95	5.52	3.08	3.54	3.85	4.80
Mont-Male	38	x̄	2.97	10.03	10.24	1.11	1.61	15.05	15.55	16.42	10.61	15.26
		σ	3.43	6.32	5.86	1.80	2.29	6.13	5.32	5.54	6.97	6.44
Mont-Female	36	x̄	2.14	7.61	8.11	2.11	1.75	16.81	16.89	18.25	11.33	16.22
		σ	2.91	6.84	6.52	2.62	2.69	3.87	2.85	1.79	5.85	4.71
Non-Mont-Male	32	x̄	7.72	13.16	14.22	3.91	6.12	13.50	15.28	15.19	10.25	13.00
		σ	4.97	4.11	5.07	3.96	4.31	6.20	4.85	4.81	6.32	6.06
Non-Mont-Female	38	x̄	6.58	13.63	14.34	5.39	5.34	13.97	16.08	15.79	10.29	13.24
		σ	4.78	3.53	3.37	4.96	4.59	5.65	3.96	3.33	6.27	5.76

Gain Score					MA	CA	Yrs. in School	Jack	Keister	
1	2	3	4	5					1	2
12.71	6.29	6.54	10.46	14.46	65.70	55.50	0.83	6.67	332.1	429.2
5.05	5.26	5.70	5.42	4.51	11.54	8.21	0.90	3.75	178.6	133.5
12.21	4.62	4.42	9.92	12.62	71.10	57.80	0.92	6.87	315.1	474.0
5.22	4.47	5.20	4.89	6.03	14.97	9.15	0.86	3.02	196.8	126.8
12.29	5.83	6.87	9.79	13.50	62.50	55.20	0.83	5.75	308.5	423.7
5.53	7.20	6.89	4.93	5.25	10.12	8.35	0.69	3.04	162.5	119.9
4.79	2.96	2.54	2.92	4.62	62.00	55.50	0.79	2.37	376.7	441.6
4.18	6.53	6.26	2.78	4.17	16.35	8.90	0.76	3.29	141.4	107.0
6.00	3.75	1.75	3.25	6.33	62.30	56.50	0.79	6.12	396.8	429.7
6.27	5.78	5.22	3.19	3.79	7.95	6.99	1.00	2.93	152.7	114.1
12.22	4.04	6.17	9.78	13.39	67.50	54.10	0.78	6.39	295.2	423.3
5.28	5.00	5.35	5.48	5.70	10.75	8.01	0.93	3.72	196.8	143.2
13.00	8.00	6.80	9.44	14.32	64.00	54.50	0.80	7.64	367.8	447.4
5.12	6.40	6.37	4.84	4.68	12.03	9.11	0.80	4.17	152.3	129.5
11.82	4.55	3.41	11.77	13.86	69.30	58.90	0.77	6.32	305.3	426.8
5.20	4.28	4.20	4.72	5.18	9.89	6.37	0.73	3.28	203.4	141.3
12.62	5.81	7.54	8.23	12.38	64.70	54.50	0.96	6.31	317.3	467.5
5.49	7.13	6.99	4.47	5.97	15.58	10.08	0.81	2.91	158.4	107.8
4.12	3.40	1.96	3.20	5.04	59.90	53.50	0.68	6.12	359.9	443.8
5.34	6.99	6.35	2.73	4.24	14.30	8.19	0.84	3.19	148.4	104.7
6.78	3.30	2.35	2.96	5.96	64.70	58.70	0.91	6.39	415.9	426.8
5.04	5.15	5.08	3.26	3.84	10.52	7.00	0.93	3.03	140.8	116.3
12.08	5.53	6.18	9.50	13.66	63.70	54.50	0.13	7.50	337.1	391.2
5.67	6.13	5.10	6.40	6.02	12.89	7.66	0.34	2.87	170.6	126.2
14.67	9.28	10.14	9.22	14.47	63.20	54.40	0.25	8.36	355.3	404.9
4.26	7.17	6.47	5.19	4.97	12.13	8.94	0.49	3.06	142.8	117.4
5.78	2.12	0.97	6.34	6.87	67.40	56.40	1.47	4.81	302.9	479.8
5.72	4.28	5.03	4.32	4.99	11.95	8.20	0.66	3.40	200.4	118.5
7.39	2.45	1.45	4.89	7.79	65.30	57.10	1.50	5.29	374.2	489.0
5.06	3.64	3.05	3.97	5.15	13.66	9.04	0.64	3.17	167.5	105.8

APPENDIX Q

TABLE

MEAN SCORES IN INITIAL AND FINAL HAPTIC TESTS

Test	Mont.	Non. Mont.	Male	Female	Exp. Ind.	Exp. Group	Total Exp.	Tot. Con.	Exp. Ind. Mont.	Exp. Ind. Non. Mont.	Exp. Gr. Mont.	Exp. Gr. Non-Mont.	Session A.M.	Session P.M.
1-Int.	2.57 3.21	7.10 4.90	5.14 4.82	4.42 4.56	4.77 4.66	5.33 5.09	5.05 4.88	4.21 4.25	2.42 3.12	7.12 4.75	3.28 3.93	7.57 5.27	5.19 4.98	4.35 6.29
Final	15.91 5.32	13.76 5.91	14.34 6.21	15.35 5.07	17.40 3.81	17.58 2.81	17.49 3.31	9.60 5.73	18.62 2.04	16.17 4.67	18.88 1.88	16.17 2.96	15.04 5.76	14.68 5.58
2-Int.	8.85 6.69	13.41 3.82	11.46 5.64	10.70 6.18	11.31 5.86	11.87 5.66	11.59 5.76	10.02 6.12	9.00 6.77	13.62 3.50	10.56 6.92	13.30 3.32	11.07 6.29	11.07 5.56
Final	16.20 4.35	15.71 4.41	15.43 5.11	16.47 3.48	17.42 3.09	17.10 2.99	17.26 3.04	13.37 5.39	18.12 1.74	16.71 3.88	17.44 2.21	16.74 3.63	15.57 4.67	16.36 4.04
3-Int.	9.20 6.28	14.29 4.23	12.06 5.85	11.31 6.02	11.35 5.85	12.48 6.21	11.92 6.03	11.19 5.70	8.67 5.37	14.04 5.01	10.12 7.36	15.04 3.03	11.81 6.24	11.54 5.65
Final	17.31 4.26	15.51 4.08	15.86 5.26	16.99 2.96	17.85 2.61	18.12 1.78	17.99 2.20	13.33 5.50	18.83 1.46	16.87 3.10	18.84 1.12	17.35 2.01	16.28 4.63	16.60 3.88
4-Int.	1.59 2.30	4.71 4.59	2.39 3.30	3.80 4.32	3.40 4.02	3.19 3.65	3.30 3.83	2.75 4.06	1.62 2.39	5.17 4.51	1.84 2.41	4.65 4.16	3.35 4.38	2.87 3.39
Final	10.96 6.46	10.27 6.29	10.44 6.68	10.80 6.09	13.00 6.19	13.04 5.64	13.02 5.92	5.83 4.20	13.83 5.66	12.17 6.58	14.08 5.51	11.91 5.59	10.54 6.52	10.71 6.26
5-Int.	1.68 2.49	5.76 4.47	3.67 4.05	3.65 4.21	3.65 4.10	4.06 4.17	3.85 4.14	3.27 4.09	1.62 2.45	5.67 4.41	2.20 3.07	6.09 4.26	4.33 4.83	2.99 3.15
Final	15.73 5.69	13.15 5.90	14.23 6.37	14.69 5.48	17.52 3.87	17.12 3.84	17.32 3.86	8.75 5.18	18.96 1.70	16.08 4.80	19.44 1.24	14.61 4.12	14.51 6.20	14.42 5.66

APPENDIX R

SUMMARY OF F-RATIOS

Variable	1		2		3		4		5	
	F	p	F	p	F	p	F	p	F	p
Between										
. Sexes	6.15	<.01	6.31	<.01	6.55	<.01	5.28	<.02	.49	.48
. Sessions	0	1.0	.35	.55	.04	.85	.68	.41	2.97	.08
. Schools	27.11	<.00	12.95	<.00	31.66	<.00	22.38	<.00	36.58	<.00
. Treatment	42.15	<.00	1.64	.19	10.11	<.00	43.35	<.00	62.89	<.00
School x Sex	.36	.55	2.76	.10	4.66	<.03	.47	.49	.16	.69
Treat. x Sex	1.13	.32	2.20	.11	.76	.47	1.33	.26	1.38	.26
Treat. x Session	.39	.67	.01	.99	1.10	.37	.44	.64	.15	.86
Treat. x School	.43	.65	1.36	.26	.25	.77	4.74	<.01	4.40	<.01
. Mental Age	2.18	.14	1.21	.27	.32	.57	1.19	.27	.16	.68
. Chronological Age	.46	.49	5.98	<.01	5.73	<.01	9.95	<.00	.00	1.00
. Previous Years in School	.84	.35	.17	.67	.87	.35	1.95	.16	1.58	.21
. Jack Test	1.49	.22	2.26	.13	.14	.69	.90	.34	2.10	.14
. Keister I	.05	.81	1.56	.21	.29	.58	.15	.69	1.08	.30
. Keister II	.12	.72	.06	.79	.05	.81	1.28	.25	2.02	.15

APPENDIX S-1

CORRELATIONS BETWEEN HAPTIC GAIN SCORES AND VARIABLES

Variable	Correlation											
	1	2	3	4	5	6	7	8	9	10	11	12
Gain Score Test 1	-	.42	.51	.53	.79	.29	.24	-.53	.53	-.53	-.04	.04
" " " 2		-	.59	.16	.37	.14	.04	-.18	.41	-.41	-.06	.06
" " " 3			-	.23	.50	.20	.10	-.30	.55	-.55	-.05	.05
" " " 4				-	.59	..27	.30	-.57	.35	-.35	-.06	.06
" " " 5					-	.34	.25	-.60	.53	-.53	-.10	.10
Exp. Ind.						-	-.50	-.50	-.02	.02	.00	.00
Exp. Group							-	-.50	.01	-.01	.00	.00
Control								-	.01	-.01	.00	.00
Montessori									-	-1.00	-.03	.03
Non-Montessori										-	.03	-.03
A.M.											-	-1.00
P.M.												-
Male												
Female												
Exp. Ind. Mont												
Exp. Ind. Non Mont												
Exp. Gr. Mont												
Exp. Gr. Non Mont												
Control Mont												
Control Non Mont												
Exp. Ind. A.M.												
Exp. Ind. P.M.												
Exp. Gr. A.M.												
Exp. Gr. P.M.												
Control A.M.												
Control P.M.												
Exp. Ind. Male												
Exp. Ind. Female												
Exp. Gr. Male												
Exp. Gr. Female												
Cont. Male												
Cont. Female												
Mont. Male												
Mont. Female												
Non Mont Male												
Non Mont Female												
M.A.												
C.A.												
Previous School												
Jack												
Keister I												
Keister II												

Sec. 1

12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
.04	-.14	.14	.44	-.07	.40	-.10	-.13	-.55	.17	.19	.15	.16	-.38	-.29	.15
.06	-.14	.14	.30	-.13	.15	-.10	.09	-.32	.07	.10	-.02	.07	-.14	-.08	-.06
.05	-.15	.15	.39	-.14	.29	-.17	.06	-.44	.12	.13	-.02	.15	-.16	-.22	.10
.06	.10	-.10	.38	-.04	.40	-.02	-.32	-.41	.10	.24	.20	.19	-.38	-.35	.18
.10	-.04	.04	.46	-.03	.47	-.16	-.22	-.54	.18	.26	.13	.19	-.44	-.32	.18
.00	-.01	.01	.63	.63	-.32	-.31	-.32	-.31	.63	.63	-.32	-.32	-.32	-.32	.62
.00	-.04	.04	-.32	-.32	.65	.62	-.32	-.31	-.32	-.32	.63	.63	-.32	-.32	-.31
.00	.05	-.05	-.32	-.32	-.32	-.31	.65	.62	-.32	-.32	-.32	-.32	.63	.63	-.31
.03	.06	-.06	.44	-.46	.45	-.45	.45	-.45	-.01	-.01	-.01	.02	-.01	.02	.01
-.03	-.06	.06	-.44	.46	-.45	.45	-45	.45	.01	.01	.01	-.02	.01	-.02	-.01
-1.00	.03	-.03	.00	.00	-.02	.02	-.02	.02	.45	-.45	.45	-.45	.45	-.45	.02
-	-.03	.03	.00	.00	.02	-.02	.02	-.02	-.45	.45	-.45	.45	-.45	.45	-.02
	-	-1.00	.01	-.02	-.01	-.04	.07	-.01	.01	-.02	-.02	-.02	.05	.01	.45
		-	-.01	.02	.01	.04	-.07	.01	-.01	.02	.02	.02	-.05	-.21	-.45
			-	-.20	-.20	-.20	-.20	-.20	.40	.40	-.20	-.20	-.20	-.20	.42
				-	-.20	-.20	-.20	-.20	.40	.40	-.20	-.20	-.20	-.20	.36
					-	-.20	-.21	-.20	-.20	-.20	.39	.43	-.20	-.20	-.20
						-	-.20	-.19	-.20	-.20	.42	-.36	-.20	-.20	-.19
							-	-.20	-.20	-.20	-.20	-.20	.39	.43	-.20
								-	-.20	-.20	-.20	-.20	.42	.36	-.19
									-	-.20	-.20	-.20	-.20	-.20	.42
										-	-.20	-.20	-.20	-.20	.36
											-	-.20	-.20	-.20	-.20
												-	-.20	-.20	-.20
													-	-.20	-.20
														-	-.20
															-

Sec. 2

27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
.15	.21	.12	.19	-.45	-.23	.19	.42	-.37	-.26	-.06	-.13	-.44	.23	-.06	-.17
-.06	.23	-.02	.07	-.11	-.11	.06	.41	-.24	-.24	-.12	-.24	-.35	.11	-.11	-.17
.10	.15	-.09	.21	-.21	-.17	.14	.50	-.32	-.32	-.24	-.35	-.45	.26	-.01	-.17
.18	.16	.33	.06	-.36	-.36	.22	.18	-.11	-.29	.22	.20	-.14	.22	-.08	-.05
.18	.26	.21	.12	-.42	-.34	.27	.34	-.33	-.29	.06	-.08	-.41	.22	-.00	-.11
.62	.65	-.30	-.33	-.32	-.31	-.02	.00	.01	.01	.04	-.11	-.02	.10	-.04	-.02
-.31	-.32	.60	.66	-.32	-.31	-.02	.03	-.02	.01	.11	.07	.05	-.05	-.13	.05
-.31	-.32	-.30	-.33	.65	.62	.04	-.03	.01	-.02	-.15	.03	-.02	-.06	.18	-.03
.01	-.03	.03	-.01	.04	-.03	.58	-.56	-.55	-.62	-.11	-.14	-.77	.41	.01	-.35
-.01	.03	-.03	.01	-.04	.03	-.58	-.56	.55	.62	.11	.14	.77	-.41	-.01	.35
.02	-.02	.00	.00	.02	-.02	.03	-.06	.00	.03	.11	-.01	.00	.10	-.01	.10
-.02	.02	..00	.00	-.02	.02	-.03	.06	.00	-.03	-.11	.01	.00	-.10	.01	-.10
.45	-.45	.44	-.46	.47	-.42	.62	-.56	.55	-.58	.04	-.02	-.09	-.07	-.13	-.07
-.45	.45	-.44	.46	-.47	.42	-.62	.56	-.55	-.58	-.04	.02	.09	.07	.13	.07
.42	.39	-.19	-.21	-.20	-.20	.24	.26	-.24	-.27	-.01	-.18	-.41	.37	-.00	-.17
.36	.43	-.19	-.21	-.20	-.20	-.27	-.26	.25	.28	.07	.04	.38	-.24	-.05	.14
-.20	-.21	.42	.40	-.21	-.20	.22	.29	-.24	-.27	.04	-.01	-.23	.09	-.10	-.20
-.19	-.20	.34	.44	-.20	-.19	-.26	-.25	.22	.30	.09	.10	.29	-.16	-.07	.27
-.20	-.21	-.19	-.22	.47	.35	.31	.20	-.24	-.27	-.18	-.00	-.38	.09	.12	-.10
-.19	-.20	-.19	-.20	.35	.43	-.26	-.25	.27	.26	-.01	.24	.36	-.17	.11	.07
.42	.39	-.19	-.21	-.20	-.20	-.01	.00	.03	-.01	.03	-.13	-.04	.11	-.03	.01
.36	.43	-.19	-.21	-.20	-.20	-.01	.00	-.01	.03	.03	-.01	.01	.02	-.03	-.04
-.20	-.20	.38	.42	-.20	-.20	-.01	.00	-.01	.03	.22	.12	.05	.04	-.07	.12
-.20	-.20	.38	.42	-.20	-.20	-.01	.04	-.01	-.01	-.08	-.02	.01	-.10	-.09	-.06
-.20	-.20	-.19	-.21	.43	.36	.07	-.09	-.01	.03	-.10	-.00	-.01	-.02	.09	.01
-.20	-.20	-.19	-.21	.39	.42	-.01	.04	.03	-.06	-.09	.04	-.01	-.05	.14	-.04
-	-.20	-.19	-.20	-.20	-.19	.26	-.25	.27	-.26	.09	-.08	-.02	-.02	-.12	-.06
	-	-.19	-.22	-.21	-.20	-.27	.24	-.24	.27	-.03	-.06	-.01	.15	.06	.03
		-	-.20	-.19	-.19	.27	-.25	.24	-.25	.15	.16	-.02	-.03	-.09	-.05
			-	-.22	-.20	-.28	.27	-.25	.25	-.01	-.06	.08	-.03	-.07	.10
				-	-.20	.31	-.26	.24	-.27	-.18	-.11	-.08	-.06	.04	.01
					-	-.26	.23	-.23	.26	-.01	.16	.05	-.02	.18	-.05
						-	-.35	-.32	-.36	-.06	-.07	-.49	.17	-.02	-.23
							-	-.31	-.35	-.07	-.08	-.39	.31	.04	-.16
								-	-.32	.10	.05	.41	-.27	-.13	.17
									-	.03	.11	.48	-.22	.11	.23
										-	.73	.35	-.13	.05	.14
											-	.41	-.15	.07	.14
												-	-.40	.01	.28
													-	.14	-.03
														-	.41
															-

Sec. 3

APPENDIX T.

ANALYSIS OF EXPERIMENTAL TREATMENT BY INDIVIDUAL VS. GROUP INSTRUCTION

Test	Montessori (df-47)		Non Montessori (df-45)		Male (df-43)		Female (df-49)	
	Individual	Group	Individual	Group	Individual	Group	Individual	Group
Test 1	$\bar{x}$ 16.21	15.60	$\bar{x}$ 9.04	8.61	$\bar{x}$ 12.22	11.82	$\bar{x}$ 13.00	12.62
	σ 2.81	3.72	σ 4.56	4.45	σ 5.28	5.20	σ 5.12	5.49
	F .43 $p > .05$		F .11 $p > .05$		F .06 $p > .05$		F .06 $p > .05$	
Test 2	$\bar{x}$ 9.12	6.88	$\bar{x}$ 3.08	3.43	$\bar{x}$ 4.04	4.55	$\bar{x}$ 8.00	5.81
	σ 6.90	6.87	σ 2.93	4.27	σ 5.00	4.28	σ 6.40	7.13
	F 1.29 $p > .05$		F .11 $p > .05$		F .14 $p > .05$		F 1.32 $p > .05$	
Test 3	$\bar{x}$ 10.17	8.72	$\bar{x}$ 2.83	2.30	$\bar{x}$ 6.17	3.41	$\bar{x}$ 6.80	7.54
	σ 5.22	7.09	σ 3.99	2.22	σ 5.35	4.20	σ 7.54	6.99
	F .65 $p > .05$		F .32 $p > .05$		F 3.72 $p < .05$		F .16 $p > .05$	
Test 4	$\bar{x}$ 12.21	12.24	$\bar{x}$ 7.00	7.26	$\bar{x}$ 9.78	11.77	$\bar{x}$ 9.44	8.23
	σ 4.91	4.96	σ 3.95	3.27	σ 5.48	4.72	σ 4.84	4.47
	F .02 $p > .05$		F .06 $p > .05$		F 1.71 $p > .05$		F .84 $p > .05$	
Test 5	$\bar{x}$ 7.33	7.24	$\bar{x}$ 10.42	8.52	$\bar{x}$ 13.39	13.86	$\bar{x}$ 14.32	12.38
	σ 2.44	2.92	σ 4.95	4.27	σ 5.70	5.18	σ 4.68	5.97
	F .01 $p > .05$		F 1.98 $p > .05$		F .08 $p > .05$		F 1.66 $p > .05$	